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Weed management in soybean with pre- and post-emergence herbicides

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ABSTRACT

A field experiment was conducted to study the efficacy of different pre- and post-emergence herbicides and their combinations to control the weeds in soybean during *Kharif* season of the year- 2012. Application of imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as post-emergence was found to be more efficient to control monocot and dicot weeds in soybean which recorded lowest weed density, dry matter and weed index. It also found superior in respect of various growth and yield attributes. Highest seed yield (2.45 t/ha) and straw yield of soybean and maximum gross return (` 81,500/-) and net return (` 56,269/-) were also recorded in imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as post-emergencewith highest B:C ratio of 3.23. It was also found responsible for highest uptake of N, P and K by soybean crop and lowest uptake of these plant nutrients by weed plants.

Key words: Growth, Imazamox, Imazethapyr, Pendimethalin, Quizalofop-ethyl, Soybean, Weed control

Losses due to weeds have been one of the major limiting factors in soybean production. Weeds compete with crop for light, moisture and nutrients, with early-season competition being the most critical. The grain yield reduction due to the weed infestation in soybean may be up to 31- 84% (Kachroo *et al*. 2003). Most of the yield reduction due to weed competition occurs during the first six weeks after planting; therefore, major emphasis on control should be given during this period. Good soybean weed control involves utilizing all methods available and combining them in an integrated weed management system, but considering the present day labour scarcity and their higher wages for cultural and mechanical weed control, the economics and feasibility of soybean cultivation is quiet disturbed. Hence the emphasis should be given to adapt the chemical methods of weed control to solve the problem of minimum available labour and their high cost. In this view, the present investigation was conducted to find out the best suitable combination of different herbicides to control weeds in soybean with lower cost and higher grain yield.

MATERIALS AND METHODS

An agronomic investigation was conducted at Agronomy Farm of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola in *Kharif* 2012 in randomized block design with eight treatments replicated thrice. The experimental site was located at 77^0 02' E longitudes and $20^0$42' N latitude with average annual rainfall of 950 mm. The soil of experimental field was clayey and slightly alkaline in reaction with pH 7.8 with low available N (221.47 kg/ha), medium P (16.86 kg/ha) and high in K (387.25 kg/ha).The gross and net plot sizes were 4.5 x 4.0 m and 3.6 x 2.8 m, respectively. The soybean variety *'JS 335'* was sown at 45 x 5 cm spacing on 2nd July of year 2012. Treatment consist of recommended practice of weed control (1 hand + 1 hoeing) and pre-emergence application of pendimethalin 1.0 kg/ha and post-emergence (PoE) application of quizalofop-ethyl 0.075 kg/ha, imazethapyr 0.100 kg/ha and its combination with 0.070 and 0.080 kg/ha of imazamox. Imazethapyr is also combined with quizalofop-ethyl as post-emergence application. Hand weeding and hoeing were given at 20 and 40 DAS, respectively. Herbicides were applied with knapsack sprayer through 500 liter of water per hectare. Pendimethalin was applied as pre-emergence at 2 DAS, while quizalofop-ethyl, imazethapyr and imazamox were applied as post-emergence at 20 DAS as per the treatment details (Table 1). The fertilizer dose of 30 kg N and 75 kg P per hectare was applied to crop through urea and single super phosphate as half of N and whole P at the time of sowing and remaining half of N was applied at 30 days after sowing. Protective irrigations were given to crop whenever dry spells appeared during the crop growth. Other plant protection practices for disease and pest control were also applied in similar manner for all the treatments. Regular biometric observations in respect of different weed parameters and growth attributes of crop were recorded at regular interval during the crop growth, however the observation data at peak growth stage *i.e.* 80 DAS, is discussed in results and discussion.

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The weed control efficiency was calculated by using the following formula:

$$WCE\ (\%) = \frac{DWC - DWT}{DWC} \times 100$$

(Where, WCE = Weed control efficiency in percent, DWC = Dry matter weight of weed in control plot and DWT = Dry matter weight of weed in treated plot).

Weed index was computed by the formula given below-

$$\text{Weed Index (WI) } \% \frac{X - Y}{X} \times 100$$

(Where, X = weight of seed yield (t/ha) in treatment which has highest yield and Y = weight of seed yield (t/ha) in treatment for which weed index is to be calculated).

RESULTS AND DISCUSSION

Effect on weed parameters

Different dicot weed species observed in experimental field were *Lagasia mollis, Euphorbia hirta, Digera arvensis, Tridex procumbense, Parthenium hysterophorus, Celosia argentea, Euphorbia geniculata, Alysicarpus rugosus, Alternanathera triandra, etc*. Different monocot weed species observed were *Commelina benghalensis, Dinebra arabica, Poa annua, Echinochloa crusgalli, Eragrostis major, Cynodon dactylon, Cyperus rotundus, etc*. Treatment application of imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as PoE was found to be superior for controlling monocot and dicot weeds in soybean which recorded lowest weed count of these weeds, however it was found to be on par with 1 hand weeding + 1 Hoeing, pendimethalin1.0 kg/ha as PE, premix imazethapyr + imazamox 0.070 kg/ha as PoE and premix imazethapyr + imazamox 0.080 kg/ha as PoE in respect of monocot weeds and quizalofop-ethyl 0.075 kg/ha as PoE, imazethapyr 0.100 kg/ha as PoE, premix imazethapyr + imazamox 0.070 kg/ha as PoE and premix imazethapyr + imazamox 0.080 kg/ha as PoE in respect of dicot weeds. This might be due to the action of different pre and post emergence herbicides used in soybean. The primary mode of action of pendimethalin is to inhibit microtubule formation in cells of susceptible monocot and dicot weeds which are an important part of the cell division process. As a result of restricted cell division, growth of the emerging weed seedling is prevented, eventuating in death due to lack of food reserves. Similar results of application of pendimethalin in soybean were also reported by Malik *et al.* (2006). Post emergence application of imazethapyr is responsible for inhibition of acetolactate synthase (ALS) or acetohydroxyacid synthase (AHAS) in broad leaf weeds which caused destruction of these weeds at 3-4 leaf stage (Chandel and Saxena 2001). Quizalofop-ethyl inhibit the activity of the acetyl-CoA carboxylase enzyme, which is necessary for fatty acid synthesis in grassy weeds. These effects of quizalofop for controlling weeds in soybean were in confirmation with the earlier results reported by Pandey *et al.* (2007). Lowest weed dry matter, weed index and highest weed control efficiency was found in imazethapyr 0.100 kg/ha + quizalofop ethyl 0.075 kg/ha as PoE (Table 1).

Effect on growth and yield attributing characters, yield and economics

Different weed control treatments were found to be significantly affecting to various growth and yield attributing characters in soybean over control treatment. Taller plants and highest plant dry matter were observed in application of imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as PoE over all the other treatments. This might be due to providing favorable environment for crop with controlling

Table 1. Effect of different weed control treatments on weed parameters in soybean at 80 DAS

Treatment	Weed density (no./m^2)		Weed dry matter (g)	Weed control efficiency (%)	Weed index (%)
	Monocot	Dicot			
T_1- Weedy check	37.3	36.6	25.4	-	60.1
T_2- One hand weeding + 1 hoeing	25.0	25.6	18.2	56.7	10.5
T_3- Pendimethalin as 1.0 kg/ha PE	24.6	25.6	14.2	51.4	6.99
T_4- Quizalofop ethyl 0.075 kg/ha PoE	27.6	24.0	14.4	48.4	18.1
T_5- Imazethapyr 0.100 kg/ha PoE	28.3	25.0	14.6	49.3	11.1
T_6- Imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha PoE	23.3	21.6	13.9	64.9	-
T_7- Premix imazethapyr + imazamox 0.070 kg/ha PoE	25.0	23.0	15.8	56.5	13.1
T_8- Premix imazethapyr + imazamox 0.080 kg/ha PoE	23.6	22.6	15.0	51.1	9.52
LSD (P = 0.05)	2.99	3.95	4.82	-	-

PE = pre-emergence, PoE= post-emergence

Table 2. Effect of different weed control treatments on various growth and yield attributing characters, yield and economics of soybean

Treatment	Plant height at 80 DAS (cm)	Plant dry matter at 80 DAS (g)	Number of pods per plant	100 seed weight (g)	Seed yield (t/ha)	Straw yield (t/ha)	Cost of cultivation (x10^3 `/ha)	Net return (x10^3 `/ha)	B:C ratio
T_1	52.1	12.3	26.0	10.4	0.98	1.27	22.5	9.99	1.44
T_2	63.3	16.6	38.3	11.4	2.19	2.91	25.9	47.0	2.81
T_3	63.5	12.3	40.6	11.6	2.27	3.15	24.1	51.8	3.16
T_4	60.9	13.1	33.0	11.2	2.00	2.70	23.6	43.1	2.82
T_5	59.2	15.3	35.3	11.9	2.17	3.07	24.1	48.5	3.01
T_6	64.1	18.7	45.3	12.0	2.45	3.23	25.2	56.2	3.23
T_7	63.2	17.5	36.3	11.3	2.13	2.96	22.7	48.3	3.13
T_8	61.3	16.4	34.0	10.9	2.1	3.08	22.7	51.2	3.03
LSD (P=0.05)	6.01	3.94	3.56	0.56	0.27	0.62	-	10.1	-

weeds, which reduces the competition of crop with weeds for space, air, sunlight, moisture and nutrients. Significantly higher number of pods and seed weight per plant were found in imazethapyr 0.100 kg/ha + quizalofop- ethyl 0.075 kg/ha as PoE over all the other treatments. Similar results were earlier reported by Kalhapure *et al.* (2011). Imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as PoE was recorded highest 100 seed weight, seed yield and straw yield per hectare, gross return, net return and B:C ratio as compared to all the other treatments (Table 2). The improvement in yield and economical parameters which resulted from better weed control with different weed management practices in soybean was also earlier reported by Sharma (2000) and Raskar and Bhoi (2002).

Nutrient uptake by crop and weed

Highest uptake of N, P and K per hectare by soybean crop was observed in application of imazethapyr 0.100 kg/ha + quizalofop ethyl 0.075 kg/ha as PoE, however it was on par with 1 hand weeding + 1 hoeing, pendimethalin as PE 1.0 kg/ha as PE and premix imazethapyr + imazamox 0.080 kg/ha as PoE in the case of N and with pendimethalin as PE1.0 kg/ha as PE and premix imazethapyr + imazamox 0.080 kg/ha as PoE for P and with imazethapyr 0.100 kg/ha as PoE in respect of K. The uptake of N, P and K by weeds was also found significantly lower in imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as PoE over all the other treatments (Table 3).

Table 3. Effect of different weed management treatments on nutrient uptake by soybean crop and weed plants

Treatment	Nutrient uptake by crop (kg/ha)			Nutrient uptake by weeds (kg/ha)		
	N	P	K	N	P	K
T_1	60.2	8.74	18.3	12.0	5.47	7.71
T_2	137.1	22.1	53.5	7.40	1.97	3.23
T_3	143.1	24.1	58.4	5.30	0.51	0.43
T_4	124.3	19.5	47.6	6.15	0.71	0.93
T_5	136.7	22.4	54.5	6.50	0.81	1.24
T_6	155.4	25.7	66.4	4.80	0.29	0.39
T_7	132.7	21.5	52.6	7.20	1.21	1.77
T_8	139.1	23.2	56.4	6.85	0.97	1.51
LSD(P = 0.05)	18.5	2.90	7.64	1.62	0.07	0.03

It can be concluded that, application of imazethapyr 0.100 kg/ha + quizalofop-ethyl 0.075 kg/ha as post emergence is the best weed management practice in soybean to obtain greater yield and economic return with more efficient weed control.

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