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Weed control in soybean with propaquizafop alone and in mixture with imazethapyr

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ABSTRACT

A field experiment was conducted at the Product Testing Unit, JNKVV, Jabalpur during *Kharif* season 2013 and 2014 to adjudge the efficacy of propaquizafop and imazethapyr mixture against weeds in soybean. Grassy weeds were predominant (76.25%) in the experimental field compared with broad-leaved weeds (23.75%). However, *Echinochloa colona* (33.90%) and *Dinebra retroflexa* (23.90%) were predominant in soybean but, other weeds (*Cyperus rotundus, Cynodon dactylon, Alternanthera philoxeroides, Eclipta alba and Mollugo pentaphylla*) were also present. Post-emergence application of propaquizafop (75 g/ha) alone curbed only grassy weeds. However, its efficacy was improved when applied in combination with imazethapyr being higher under propaquizafop + imazethapyr mixture applied at 53 + 80 g/ha or higher rate (56 + 85 g/ha). Yield attributing characters and yield were superior under propaquizafop + imazethapyr mixture applied at 56 + 85 g/ha followed by 53 + 80 g/ha which were comparable to hand weeding twice at 20 and 40 DAS.

Key words: Economics, Imazethapyr, Propaquizafop, Soybean, Weed control, Yield

Soybean (*Glycine max* (L) Merrill) is called "Miracle crop" of the 21st century because of its multiple uses. Being a rainy season crop, it suffers severely due to weed stress. If weeds are not controlled during critical period of crop-weed competition, there is identical reduction in the yield of soybean from 58 to 85%, depending upon the types and intensity of weeds (Kewat *et al.* 2000). Presently, imazethapyr is being in use as a post-emergence herbicide for controlling weeds in soybean to a level of satisfaction (Patel *et al*. 2009). However, its efficacy has not been tested with propaquizafop for wide spectrum weed control in soybean. Keeping the above facts in view, the present investigation was under taken to find out suitable dose of propaquizafop and imazethapyr mixture for effective control of weeds and higher seed yield of soybean.

MATERIALS AND METHODS

A field experiment was conducted at the Product Testing Unit, JNKVV, Jabalpur during *Kharif* 2013 and 2014. The soil of the experimental field was black clay soil having pH 7.2, EC 0.32 dS/m, OC 0.62%, available N, P, K 365, 16, 327 kg/ha, respectively. The nine treatments comprising of four doses of propaquizafop + imazethapyr mixture (47 + 70, 50 + 75, 53 + 80 and 56 + 85 g/ha), alone application of propaquizafop (75 g/ha) and imazethapyr (100 g/ha) as post-emergence at 15 days after sowing and pendimethalin (1000 g/ha) as pre-emergence at 2 days after sowing, hand weeding twice at 20 and 40 DAS including weedy check, were laid-out in randomized block design with three replications. Soybean variety '*JS 97-52*' was grown in the experimental field with recommended package of practices. Fertilizers were applied uniformly at 20, 60 and 20 kg N, P and K/ha, respectively. All the herbicides were applied by manually operated knapsack sprayer fitted with flat fan nozzle using spray volume of 500 L/ha. The species-wise weed population was recorded by the least-count quadrat (0.25 m^2) method at 30 DAA. Similarly the weed biomass was recorded and weed-control efficiency was calculated accordingly. The economic analysis of each treatment was done on the basis of prevailing market prices of the inputs used and outputs obtained under each treatment.

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RESULTS AND DISCUSSION

Effect on weeds

The weed density averaged over two seasons revealed that grassy weeds (76.25%) were dominant in soybean compared to non grassy weeds (23.75%). *Echinochloa colona* was rampant (33.90%) amongst the grassy weeds closely followed by *Dinebra retroflexa* (23.90%). However, other monocot weeds like *Cyperus iria* (11.44%) and *Cynodon dactylon*

(7.00%) and dicot weeds like *Alternanthera philoxeroides* (7.50%), *Eclipta alba* (8.24%) and *Mollugo pentaphylla* (8.08%) were also present in less numbers with soybean in weedy check plots.

All the weed contol treatments identically reduced the density of individual weed species including dry weight over weedy check, which had the maximum density of weeds (279.33/m^2) and weed dry weight (535.63 g/m^2). Post-emergence application of propaquizafop (75 g/ha) alone gave effective control of grassy weeds (*Echinochloa colona*, *Dinebra retroflexa*, *Cynodon dactylon*) but failed to curb broad-leaved weeds (*A. philoxeroides, E. alba and M. pentaphylla*). However, its efficacy was improved when applied in combination with imazethapyr at 53 + 80 g/ha or higher rate (56 + 85 g/ha) and reduced the population of *Echinochloa colona*, *Dinebra retroflexa*, *Cyperus rotundus, Cynodon dactylon, Alternanthera philoxeroides, Eclipta alba* and *Mollugo pentaphylla* to the tune of 83.5, 78.1, 67.4, 65.5, 70.7, 73.3 and 70.6%, respectively and proved superior over lower rates of mixture and alone application of propaquizafop (75 g/ha), pendimethalin (1000 g/ha) and even to imazethapyr (100 g/ha) applied alone (Table 1). The results were in close conformity to the findings of Tiwari and Mathew (2002) and Pradhan *et al.* (2010). Post-emergence application of propaquizafop + imazethapyr mixture at the lowest rate (47 + 70 g/ha) curtailed the weed biomass production to the tune of 61.4% at 30 DAA. But, the reduction in weed biomass was well marked when applied at higher rates being higher when propaquizafop + imazethapyr mixture was applied at 53 + 80 g/ha or higher rate (56 + 85 g/ha). The presence of propaquizafop + imazethapyr mixture in non lethal concentration at the site of action could be the reason for poor activity of propaquizafop + imazethapyr mixture when applied at the lowest dose (47 + 70 g/ha) but, the reverse was true when it was applied at higher rates. However, none of the herbicidal treatments proved superior over hand weeding twice which caused 98.9% reduction in weed biomass due to elimination of all sorts of weeds during the course of weeding. Similar views were also endorsed by Singh and Jolly (2004).

Effect on yield reduction

Yield reduction due to presence of weeds in soybean was maximum (63.1%) in weedy plots, which was arrested in the plots receiving mechanical and chemical weed control measures. Alone application of pendimethalin (1000 g/ha) as pre-emergence, propaquizafop (75 g/ha) and imazethapyr (100 g/ha) as post-emergence scaled down the yield reduction to the tune of 50.3, 41.4 and 37.5%, respectively. However, post-emergence application of propaquizafop + imazethapyr mixture checked the yield reduction identically (7.9%) at 53 + 80 g/ha or

Table 1. Influence of herbicides on weed population (30 DAA), weed biomass, weed control efficiency and weed index at harvest in soybean (mean data of 2 seasons)

Treatment	Weed population (no./m^2)							Weed biomass (g/m^2)	WCE (%)	Weed index (%)
	Echinochloa colona	*Dinebra retroflexa*	*Cyperus iria*	*Cynodon dactylon*	*Alternanthera philoxeroides*	*Eclipta alba*	*Mollugo pentaphylla*			
Propaquizafop + imazethapyr (47 + 70 g/ha) 15 DAS	6.15 (37.33)	5.21 (26.67)	4.49 (19.67)	3.48 (11.67)	3.67 (13.00)	3.62 (12.67)	3.76 (13.67)	14.41 (207.08)	61.34	33.01
Propaquizafop + imazethapyr (50 + 75 g/ha)	5.67 (31.67)	4.98 (24.33)	4.22 (17.33)	3.33 (10.67)	3.49 (11.67)	3.29 (10.33)	3.29 (10.33)	13.25 (175.13)	67.30	22.86
Propaquizafop + imazethapyr (53 + 80 g/ha) 15 DAS	5.08 (25.33)	4.49 (19.67)	3.81 (14.00)	3.08 (9.00)	2.97 (8.33)	2.85 (7.67)	2.96 (8.33)	11.79 (138.53)	74.14	7.95
Propaquizafop + imazethapyr (56 + 85 g/ha) 15 DAS	4.06 (16.00)	3.89 (14.67)	3.29 (10.33)	2.61 (6.33)	2.48 (5.67)	2.61 (6.33)	2.68 (6.67)	9.95 (98.60)	81.59	6.89
Propaquizafop (75 g/ha) 15 DAS	5.84 (33.67)	5.08 (25.33)	4.56 (20.33)	3.29 (10.33)	3.89 (14.67)	4.26 (17.67)	3.89 (14.67)	14.19 (200.99)	62.48	41.44
Imazethapyr (100 g/ha) 15 DAS	6.23 (38.33)	5.49 (29.67)	4.05 (16.00)	3.48 (11.67)	3.13 (9.33)	3.02 (8.67)	3.23 (10.00)	14.04 (196.71)	63.27	37.54
Pendimethalin (1000 g/ha) 2 DAS	6.69 (44.33)	5.90 (34.33)	4.88 (23.33)	3.89 (14.67)	4.10 (16.33)	4.45 (19.33)	4.22 (17.33)	15.77 (248.16)	53.67	50.28
Hand weeding (2) 20 and 40 DAS	1.86 (3.00)	2.04 (3.67)	1.95 (3.33)	1.46 (1.67)	1.46 (1.67)	1.34 (1.33)	1.34 (1.33)	2.56 (6.07)	98.87	0.00
Weedy check	9.86 (96.67)	8.22 (67.00)	5.67 (31.67)	4.33 (18.33)	4.45 (19.33)	4.91 (23.67)	4.81 (22.67)	23.15 (535.63)	0.00	63.06
LSD (P=0.05)	0.33	0.27	0.37	0.43	0.31	0.39	0.40	0.28	-	-

Table 2. Influence of herbicides on yield attributing traits, yield and economics of soybean (mean data of 2 seasons)

Treatment	Doses	Pods/ plant	Seeds/ pod	Seed index (g)	Seed yield (t/ha)	Haulm yield (t/ha)	GMR ($x10^3$ `/ha)	NMR ($x\ 10^3$ `/ha)	B:C Ratio
Propaquizafop + imazethapyr	47 + 70 g/ha	31.40	2.20	6.76	1.59	3.45	44.31	23.68	2.15
Propaquizafop + imazethapyr	50 + 75 g/ha	34.67	2.23	6.84	1.83	3.99	51.04	30.32	2.46
Propaquizafop + imazethapyr	53 + 80 g/ha	40.00	2.27	7.01	2.19	4.33	60.47	39.66	2.91
Propaquizafop + imazethapyr	56 + 85 g/ha	40.67	2.27	7.01	2.21	4.35	61.14	40.23	2.92
Propaquizafop	75 g/ha	27.53	2.23	6.41	1.39	3.18	38.89	19.11	1.97
Imazethapyr	100 g/ha	30.40	2.23	6.55	1.48	3.35	41.44	20.98	2.02
Pendimethalin	1000 g/ha	25.93	2.17	6.15	1.18	2.71	33.02	11.96	1.58
Hand weeding	2	41.33	2.33	7.18	2.38	4.57	65.56	36.14	2.23
Weedy check	-	21.80	2.03	5.92	0.88	2.44	24.96	6.04	1.32
LSD (P=0.05)	-	2.52	NS	0.22	0.19	0.27	-	-	-

higher rate 56 + 85 g/ha (6.9%) and proved superior to its lower rates (47 + 70 and 50 + 75 g/ha). Similar results were reported by Pradhan *et al.* (2010) on application of propaquizafop + imazethapyr mixture

Effect on crop

Yield attributing traits and seed yield in soybean was affected significantly due to different weed control treatments (Table 2). The values of yield attributing traits, *viz.* pods/plant, seeds/pod and seed index, were superior under propaquizafop + imazethapyr mixture applied at 53 + 80 and 56 + 85 g/ha and these proved significantly superior to its lower rates (47 + 70 and 50 + 75 g/ha), alone application of propaquizafop (75 g/ha), imazethapyr (100 g/ha), pendimethalin (1000 g/ha) and weedy check but was comparable to hand-weeding. The seed and haulm yields of soybean increased appreciably when the weeds were controlled either by herbicides or hand-weeding. The seed and haulm yields were lower when propaquizafop + imazethapyr was applied at the lowest rate (47 + 70 g/ha) but these were increased further with corresponding increase in application rates being higher at rate 53 + 80 and 56 + 85 g/ha. However, hand weeded plots recorded maximum seed and haulm yields and proved significantly superior to other herbicidal treatments but at par to propaquizafop + imazethapyr mixture applied at 53 + 80 and 56 + 85 g/ha. Similar views have been reported by Singh and Singh (2000).

Economics

Minimum net monetary returns was fetched under weedy check plots as a result of lower seed and haulm yields. However, post-emergence application of propaquizafop + imazethapyr mixture at 53 + 80 or higher rate (56 + 85 g/ha) was found more remunerative, as they fetched higher net monetary returns and benefit-cost ratio. The low investment under combined application of propaquizafop and imazethapyr (53 + 80 g/ha and 56 + 85 g/ha) as post-emergence coupled with good economic yield might be the reason for higher NMR and B:C ratio over lower rates of propaquizafop + imazethapyr mixture (47 + 70 and 50 + 75 g/ha), alone application of propaquizafop (75 g/ha), imazethapyr (100 g/ha), pendimethalin (1000 g/ha) and even to hand weeding as advantage of maximum gross monetary returns was nullified due to higher variable cost for control of weeds (` 10,500 /ha). Similar findings have also been reported by Kewat *et al.* (2000) and Tiwari *et al.* (2007).

It was concluded that post-emergence application of propaquizafop + imazethapyr mixture at 53 + 80 g/ha found more remunerative compared to alone application of propaquizafop (75 g/ha), imazethapyr (100 g/ha), pendimethalin (1000 g/ha) and even to hand weeding twice.

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