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Effect of Stage and Doses of Application of Flumioxazin on Weeds and Seed Yield of Soybean

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Soybean is the most important and valuable oilseed crop of India. Of the different reasons of low productivity, weed control assumes the top most priority for harnessing higher productivity of soybean. Soybean crop is often infested with grassy, broad-leaved weeds and sedges which compete with crop, resulting in decrease in yield to the tune of 26 to 71% depending upon the type and intensity of weeds and their occurrence (Jain *et al.*, 1997; Kewat and Pandey, 2001). Presently fluchloralin, trifluralin, metolachlor, alachlor and pendimethalin are being used for controlling weeds in soybean. But most of the time, these herbicides have not been much effective in curbing the weed menace under diversified weed flora. Recently introduced flumioxazin is reportedly broad spectrum. Hence, an attempt has been made to study the effect of stages and doses of application of flumioxazin in soybean.

A field experiment was conducted at National Research Centre for Weed Science, Jabalpur during **kharif** season of 2004-05. The soil of the experimental field was clayey in texture and neutral in reaction (pH 7.3). The available N, P and K in the soil were 375, 15 and 296 kg ha^{-1}, respectively. Eleven weed control treatments consisting of flumioxazin at 30, 45, 60 and 90 g ha^{-1} as pre-plant incorporation as well as pre-emergence, metribuzin at 500 g ha^{-1} as pre-emergence, hand weeding twice at 20 and 40 DAS and weedy check, were laid out in randomized block design and replicated three times. Soybean variety JS-335 was sown on June 30, 2004 at 80 kg seed ha^{-1} at row spacing of 45 cm. A uniform dose of 20 kg N through urea, 80 kg P_2O_5 through single super phosphate and 20 kg K_2O ha^{-1} through muriate of potash was applied as basal dressing. Herbicides were applied by knapsack sprayer using flat fan nozzle at a spray volume of 600 l ha^{-1}. The selling price of flumioxazin and metribuzin for calculating the cost of cultivation was considered as Rs. 1500 and 1800 ha^{-1}, respectively. Whereas cost of two weedings amounted to Rs. 5600 ha^{-1} for 80 man days.

Weeds in unweeded plot at 60 days after sowing were *Cyperus rotundus* (23.6%), *Echinochloa colona* (18.4%), *Commelina benghalensis* (13.1%), *Parthenium hysterophorus* (13.1%), *Physalis minima* (13.1%), *Euphorbia geniculata* (13.1%) and *Xanthium strumarium* (5.2%).

Flumioxazin at 90 g ha^{-1} as pre-emergence controlled *E. colona, C. rotundus, C. benghalensis, P. hysterophorus, P. minima, E. geniculata* and *X. strumarium* and proved its superiority over its lower doses (30, 45 and 60 g ha^{-1}) applied either pre-plant incorporation or pre-emergence including 90 g ha^{-1} as pre-plant incorporation but comparable to metribuzin at 500 g ha^{-1}. Two hand weedings at 20 and 40 DAS eliminated almost all the weeds associated with soybean (Table 1).

Germination and emergence of soybean seedlings were not affected due to flumioxazin and metribuzin (Table 2). Flumioxazin at 90 g ha^{-1} as pre-emergence produced more pods per plant (33) and seed index (11 g) compared to other treatments of flumioxazin and being comparable to metribuzin at 500 g ha^{-1}. Maximum reduction in weed growth coupled with no inhibitory effects on soybean seedlings under both the treatments, resulted in relatively better yield attributing traits.

Flumioxazin at 90 g ha^{-1} and metribuzin at 500 g ha^{-1} both as pre-emergence attained the higher seed yields (1184 and 1221 kg ha^{-1}) because of relatively low competitional stress and better yield attributes and both proved superior over lower doses of flumioxazin applied either pre-plant incorporation or pre-emergence including 90 g ha^{-1} as pre-plant incorporation due to poor weed control. However,

Table 1. Influence of weed control treatments on density and dry weight of dominant weeds at 60 days after sowing of soybean

Treatment	Dose g ha^{-1}	Application stage	*E. colona*		*C. rotundus*		*C. benghalensis*		*P. hysterophorus*		*P. minima*		*E.geniculata*		*X.strumarium*	
			Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})	Density (No. m^{-2})	Dry weight (g m^{-2})
Flumioxazin	30	Pre-plant	2.67	4.33	2.79	3.73	1.95	2.86	1.95	2.99	1.85	3.35	1.85	3.47	1.85	4.39
			(6)	(18)	(7)	(13)	(3)	(7)	(3)	(8)	(3)	(10)	(3)	(11)	(3)	(18)
Flumioxazin	45	Pre-plant	2.41	3.37	2.38	2.88	1.85	2.63	1.77	2.59	1.67	2.82	1.58	2.76	1.58	3.29
			(5)	(10)	(5)	(7)	(3)	(6)	(2)	(6)	(2)	(7)	(2)	(7)	(2)	(10)
Flumioxazin	60	Pre-plant	1.95	2.97	2.03	2.48	1.45	2.07	1.34	2.10	1.22	2.06	1.22	1.89	1.22	2.22
			(3)	(8)	(3)	(5)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(4)
Flumioxazin	90	Pre-plant	1.76	2.07	1.71	1.86	1.22	1.87	1.22	1.98	1.22	1.46	1.22	1.39	1.22	1.17
			(2)	(3)	(2)	(2)	(1)	(3)	(1)	(3)	(1)	(1)	(1)	(1)	(1)	(1)
Flumioxazin	30	Pre-em.	3.23	4.16	3.28	3.68	1.67	3.18	1.67	3.27	1.77	3.52	1.77	3.68	1.58	4.90
			(9)	(16)	(10)	(13)	(2)	(9)	(2)	(10)	(2)	(11)	(2)	(13)	(2)	(23)
Flumioxazin	45	Pre-em.	1.85	2.53	1.85	2.46	1.46	2.45	1.46	2.42	1.34	2.62	1.46	2.47	1.22	2.70
			(3)	(5)	(3)	(5)	(1)	(5)	(1)	(5)	(1)	(6)	(1)	(5)	(1)	(6)
Flumioxazin	60	Pre-em.	1.67	2.18	1.58	2.10	1.22	1.99	1.22	1.93	1.05	1.94	1.05	1.81	0.87	1.75
			(2)	(4)	(2)	(3)	(1)	(3)	(1)	(3)	(0)	(3)	(0)	(2)	(0)	(3)
Flumioxazin	90	Pre-em.	1.46	1.54	1.34	1.58	1.22	1.37	1.05	1.41	0.70	1.32	0.70	0.70	0.70	1.23
			(1)	(1)	(1)	(2)	(1)	(1)	(0)	(1)	(0)	(1)	(0)	(0)	(0)	(1)
Metribuzin	500	Pre-em.	1.87	1.70	1.58	1.65	1.22	1.31	1.05	1.13	0.87	1.04	0.70	0.70	0.70	0.70
			(3)	(2)	(2)	(2)	(1)	(1)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Weedy	-	-	2.72	6.72	3.02	5.11	2.34	3.59	2.27	3.53	2.41	3.99	2.27	4.20	1.58	5.11
			(7)	(44)	(8)	(26)	(5)	(12)	(4)	(12)	(5)	(15)	(4)	(17)	(2)	(25)
Weeding 20 & 40 DAS	-	-	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
			(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
LSD (P=0.05)	-	-	0.28	0.37	1.04	0.64	0.23	0.27	0.32	0.42	0.30	0.63	0,23	0.49	0.21	0.81

Original values are given in parentheses.

Table 2. Influence of weed control treatments on soybean and its economics

Treatment	Dose (g ha^{-1})	Application stage	Plant population 15 DAS (No. m^{-2})	Pods $plant^{-1}$	Seed index (g)	Seed yield (kg ha^{-1})	Net return (Rs. ha^{-1})	Benefit : cost ratio
Flumioxazin	30	Pre-plant	39	16.1	9.2	831	926	1.11
Flumioxazin	45	Pre-plant	39	22.0	9.6	936	1972	1.24
Flumioxazin	60	Pre-plant	39	26.2	9.9	964	2210	1.27
Flumioxazin	90	Pre-plant	38	28.9	10.9	980	2290	1.28
Flumioxazin	30	Pre-em.	38	17.3	9.1	848	1108	1.13
Flumioxazin	45	Pre-em.	39	19.5	9.4	1012	2802	1.34
Flumioxazin	60	Pre-em.	39	23.1	9.9	1068	3327	1.40
Flumioxazin	90	Pre-em.	39	33.1	11.2	1183	4430	1.54
Metribuzin	500	Pre-em.	39	374	11.3	1220	3798	1.41
Weedy		-	-	8.9	8.7	506	-2271	0.70
Weeding 20 & 40 DAS		-	-	47.2	11.9	1363	1139	1.08
LSD (P=0.05)		-	NS	4.0	0.6	60	-	-

NS–Not Significant.

flumioxazin at 90 g ha^{-1} and metribuzin at 500 g ha^{-1} both as pre-emergence were inferior to two weedings which produced the highest seed yield (1363 kg ha^{-1}).

Flumioxazin at 90 g ha^{-1} as pre-emergence recorded the highest value of net monetary returns (Rs. 4430 ha^{-1}) and B : C ratio (1.54) and proved superior over two weedings.

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