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Compatibility of Clodinafop-propargyl and Fenoxaprop-p-ethyl with Carfentrazone-ethyl, Metsulfuron-methyl and 2, 4-D

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ABSTRACT

Clodinafop-propargyl was compatible with metsulfuron-methyl and carfentrazone-ethyl as tank mixture with respect to the control of *Phalaris minor* and *Chenopodium album* in wheat. Fenoxaprop-p-ethyl was compatible with carfentrazone-ethyl and not with metsulfuron-methyl. Clodinafop as well as fenoxaprop had no compatibility with 2, 4-D. The mixed population of *P. minor* and *C. album* caused 66% reduction in wheat grain yields in weedy plots, whereas competition with *C. album* caused 22% reduction in wheat yield.

INTRODUCTION

Phalaris minor Retz. (canary grass) became a serious problem in wheat growing areas with the introduction and large area adoption of high yielding dwarf wheat varieties in India. Several herbicides like nitrofen, methabenzthiazuron, metoxuron, pendimethalin, terbutryn and diclofop-methyl were evaluated for effective and economical control of *P. minor* during seventies. But none of them provided desired results and could not become popular among the farmers. Isoproturon after large scale trials and demonstrations was recommended for the control of this weed in wheat during 1980-81 and it became popular among the farmers because of higher efficacy, easy application and relatively economical cost. The use of this herbicide is still continuing but after 10-12 years of its continuous use in Punjab and Haryana under rice-wheat system with heavy soil type and where burning of rice straw was practised, development of isoproturon resistant biotypes was reported (Harrington *et al.*, 1992; Malik and Singh, 1994). The infestation of this weed reached menacing proportions in part of Haryana and Punjab. Search for new herbicide molecules was made and herbicides like clodinafop-propargyl, fenoxaprop-p-ethyl and sulfosulfuron were recommended as alternative to isoproturon. Clodinafop-propargyl and fenoxaprop-p-ethyl have been very effective against *P. minor* and *Avena ludoviciana* but ineffective against non-grassy weeds. Use of these herbicides has resulted in proliferation of non-grassy weeds like *Chenopodium album, Melilotus* spp., *Medicago denticulata, Lathyrus aphaca* and *Rumex* spp. in wheat. 2, 4-D being used commonly for the control of non-grassy weeds in wheat was not compatible with these two herbicides and farmers have to go for sequential application which adds to the cost of weed management. Keeping this problem in view, trials were conducted to find out a suitable herbicide to be used as tank mixture with clodinafop-propargyl and fenoxaprop-p-ethyl to widen the weed control spectrum including grasses and non-grasses.

MATERIALS AND METHODS

Two separate field trials were conducted during winter seasons of 2002-03, 2003-04 and 2004-05 at the Crop Research Centre of G. B. Pant University of Agriculture & Technology, Pantnagar, India to study the compatibility of tank mixing of carfentrazone-ethyl at 15 and 20 g ha^{-1}, metsulfuron-methyl (MSM) at 4 g ha^{-1} and 2, 4-D at 500 g ha^{-1} with clodinafop and fenoxaprop-p-ethyl at their recommended doses with particular reference to *P. minor* and *C. album* in wheat. Each experiment, one for clodinafop and another for fenoxaprop, with 10 treatments (Tables 1 and 2) and three replications was laid out in randomized block design. Herbicides were applied as tank mixture at spray volume of 500 l ha^{-1}. Wheat

Table 1. Effect of tank mix application of clodinafop-propargyl with other herbicides on weed density (No. m^{-2}) in wheat

Treatment	Dose	2002-03						2003-04						2004-05					
	(g ha^{-1})	*P. minor*			*C. album*			*P. minor*			*C. album*			*P. minor*			*C. album*		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Clodinafop	60	257	27	3	38	34	31	322	5	0	48	43	39	290	7	0	23	19	18
Clodinafop+ Carfentrazone	60+ 15	255	25	4	32	1	0	339	7	0	49	0	0	283	0	0	20	0	0
Clodinafop+ Carfentrazone	60+ 20	267	23	3	40	2	0	341	3	0	45	0	0	298	0	0	20	0	0
Clodinafop+ 2, 4-D	60+ 500	233	119	111	41	3	0	348	217	196	43	0	0	293	173	168	28	0	0
Clodinafop+ Metsulfuron	60+ 4	253	26	5	61	5	0	318	6	0	44	0	0	288	0	0	29	0	0
Carfentrazone	20	249	235	236	59	0	0	227	219	196	49	0	0	287	258	247	28	0	0
2,4-D	500	251	245	239	63	4	0	219	223	111	47	0	0	285	261	231	30	0	0
Metsulfuron	4	244	235	227	43	0	0	220	227	119	45	0	0	285	257	237	32	0	0
Weed-free	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weedy	-	269	247	235	48	35	30	320	229	211	51	44	41	283	248	235	33	27	22

Table 2. Effect of tank mix application of fenoxaprop-p-ethyl with other herbicides on weed density (No. m^{-2}) in wheat

Treatment	Dose ($g\ ha^{-1}$)	2002-03						2003-04						2004-05					
		P. minor			*C. album*			*P. minor*			*C. album*			*P. minor*			*C. album*		
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Fenoxaprop	90	236	4	1	80	77	75	337	11	3	44	56	52	287	0	0	31	28	22
Fenoxaprop+ Carfentrazone	90+ 15	229	9	1	73	3	0	311	9	1	37	1	1	293	0	0	27	0	0
Fenoxaprop+ Carfentrazone	90+ 20	229	4	3	61	2	0	322	7	2	35	0	0	284	0	0	22	0	0
Fenoxaprop+ 2, 4-D	90+ 500	217	211	198	91	0	0	319	303	282	39	2	2	297	275	193	29	0	0
Fenoxaprop+ Metsulfuron	90+ 4	227	121	101	62	3	0	337	258	241	47	0	0	285	219	208	30	0	0
Carfentrazone	20	235	220	207	64	0	0	340	298	256	53	1	1	290	240	232	26	0	0
2,4-D	500	227	218	211	67	0	0	338	301	267	49	0	0	295	238	229	22	0	0
Metsulfuron	4	238	214	207	71	1	0	332	310	271	45	3	2	301	247	235	27	0	0
Weed-free	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weedy	-	237	221	205	56	49	72	342	331	227	51	47	45	288	267	261	24	19	16

cv. UP 2382 in both the trials was sown during second fortnight of November in all the three seasons. Spraying was done at 35 days after wheat sowing. To ensure enough population of *P. minor* and *C. album*, seeds of these weeds were sown uniformly at the time of field preparation. The weed density was recorded before application and after herbicide application from a fixed location in each plot to assess actual weed control efficiency of the treatments. The recommended package of practices was adopted to raise the experimental crop.

RESULTS AND DISCUSSION

The effect of treatments was assessed on the basis of density of *P. minor* and *C. album* recorded before herbicide application i. e. 30 days after wheat sowing and after herbicide application at 60 and 90 days stages (Tables 1 and 2). Clodinafop-propargyl at 60 g ha^{-1} tank mixed with carfentrazone-ethyl at 15 and 20 g ha^{-1} or metsulfuron-methyl (MSM) at 4 g ha^{-1} and fenoxaprop-p-ethyl at 90 g ha^{-1} tank mixed with carfentrazone-ethyl at both the doses were effective in controlling *P. minor* and *C. album*. The control of *P. minor* due to these combinations was similar to that of clodinafop or fenoxaprop applied alone. The efficacy of clodinafop on *P. minor* was reduced due to tank mixing of 2, 4-D. In case of fenoxaprop, tank mixing of 2, 4-D as well as MSM caused its reduced efficacy on *P. minor*. The efficacy of 2, 4-D, carfentrazone-ethyl and MSM on *C. album* was not affected due to tank mixing either with clodinafop or fenoxaprop. Reduced efficacy of fenoxaprop as tank mixture with 2, 4-D was also recorded by Banga and Yadav (2004).

On an average, there was more than 66% reduction in the grain yield of wheat due to mixed population of *P. minor* and *C. album* as recorded in weedy plots (Table 3). In plots treated with clodinafop or fenoxaprop alone, where there was almost complete control of *P. minor*, a grain yield reduction of 22.8% was recorded which was mainly due to competition with *C. album*. The grain yields obtained in plots treated with clodinafop at 60 g ha^{-1} and fenoxaprop at 90 g ha^{-1} applied alone were significantly less than that of tank mixed applications of clodinafop with carfentrazone-ethyl, MSM and fenoxaprop with carfentrazone-ethyl. Clodinafop and fenoxaprop when applied as tank mixtures with carfentrazone-ethyl at 15 or 20 g ha^{-1} produced more grain yield than tank mixing with 2,

Table 3. Effect of tank mix application of clodinafop-propargyl and fenoxaprop-p-ethyl with other herbicides on grain yield of wheat

Treatment	Dose	Grain yield (kg ha^{-1})			Treatment	Dose	Grain yield (kg ha^{-1})		
	(g ha^{-1})	2002-03	2003-04	2004-05		(g ha^{-1})	2002-03	2003-04	2004-05
Clodinafop	60	3825	3988	3750	Fenoxaprop	90	3685	3815	3700
Clodinafop+	60+	4855	4905	5000	Fenoxaprop+	90+	4705	4805	4658
Carfentrazone	15				Carfentrazone	15			
Clodinafop+	60+	4805	5001	4975	Fenoxaprop+	90+	4682	4975	4825
Carfentrazone	20				Carfentrazone	20			
Clodinafop+	60+	4080	3125	3700	Fenoxaprop+	90+	3950	3900	3750
2, 4-D	500				2, 4-D	500			
Clothnafop+	60+	4755	4985	5125	Fenoxaprop+	90+	4005	3875	3780
Metsulfuron	4				Metsulfuron	4			
Carfentrazone	20	2455	1844	1725	Carfentrazone	20	2055	1755	1685
2, 4-D	500	2480	1355	1425	2, 4-D	500	1987	1485	1720
Metsulfuron	4	2535	1457	1385	Metsulfuron	4	2152	1530	1650
Weed-free	-	4825	4985	5125	Weed-free	-	4752	4895	4900
Weedy	-	2115	1523	1430	Weedy	-	1857	1405	1685
LSD (P=0.05)		417	423	521	LSD (P=0.05)		405	414	517

4-D. Grain yields obtained from clodinafop and fenoxaprop tank mixed with carfentrazone-ethyl were at par with weed-free treatment. Thus, clodinafop-propargyl had compatibility with metsulfuron-methyl and carfentrazone-ethyl, whereas fenoxaprop-p-ethyl had compatibility with carfentrazone-ethyl only with respect to *P. minor* and *C. album* control in wheat.

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