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Bioefficacy of pinoxaden in combination with other herbicides against complex weed flora in wheat

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ABSTRACT

An experiment to evaluate the bioefficacy of pinoxaden in combination with broad-leaved herbicides 2,4-D, metsulfuron and carfentrazone in wheat was conducted at Hisar during 2006-07 and 2007-08. Dominant weed flora of the experimental fields were *Phalaris minor* among grassy weeds and *Chenopodium album, Melilotus indicia* and *Rumex dentatus* among broad-leaved weeds. The tank mix application of pinoxaden with broad-leaved herbicides proved significantly effective in reducing density and dry weight of weeds and gave 85-100 % control of broad-leaved and 100% control of *P. minor*. Tank mixing of carfentrazone with pinoxaden although caused injury in terms of yellowing of tips but injury symptoms disappeared within 15 days after spray and did not result in any detrimental effect on grain yield of wheat. Application of broad-leaved herbicides 7 days earlier than pinoxaden or 7 days after application of pinoxaden also proved effective in controlling *P. minor* and broad-leaved weeds. Tank mixture of 2,4-D with pinoxaden did not result any antagonistic effect as anticipated as is evident by number of spikes, plant height, and number of grains per panicle and grain yield with use of 2,4-D were at par with weed free check.

Key words: Antagonism, Carfentrazone, Metsulfuron, Pinoxaden, Tank mixture, 2,4-D

Little seed canary grass (*Phalaris minor*), a problematic weed of wheat in rice-wheat cropping system in north-west India has developed resistance against isoproturon (Malik and Malik 1994, Malik and Singh 1995). To tackle the resistance problem, clodinafop, fenoxaprop and sulfosulfuron have been recommended for control of grassy weeds in wheat (Walia *et.al*.1998, Chhokar and Malik 2002). Continuous use of same herbicide for many years resulted in development of resistance against some weeds which happened in case of isoproturon. Therefore, alternate herbicides were needed to evaluate to tackle the resistance problem. Earlier studies conducted on cross resistance in Punjab and Haryana of isoproturon and alternate herbicides (clodinafop, fenoxaprop and sulfosulfuron) revealed that efficacy of clodinafop has decreased from 100% during 2004-05 to 78.1% during 2006-07 (Walia *et al.* 2007). In Haryana, GR_{50} values of fenoxaprop and sulfosulfuron in 2002-03 have increased 6.2 and 2.3 times as compared to 1996-97 (Yadav and Malik 2007). The herbicide pinoxaden 5 EC at 40 - 50 g/ha was found very effective and recommended for the control of grassy weeds in wheat especially against clodinafop resistant *P. minor* biotypes without any residual toxicity to succeeding rice and sorghum crops (Walia *et al*. 2007, Punia *et al.* 2008, Punia and Yadav 2010).

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Several broad-leaved weeds are becoming a serious problem along with grassy weeds in wheat. There is need for tank mix or sequential application of herbicides like 2,4-D, carfentrazone and metsulfuron for the control of complex weed flora. Tank mix application of 2,4-D with clodinafop and fenoxaprop gave reduced control of grassy weeds because of antagonism between 2,4-D and these grass weed killers (Banga and Yadav 2004, Punia *et al*. 2004, Yadav *et al*. 2010). Keeping this in view, efforts were made to explore the possibility of using pinoxaden in tank mixture with 2,4-D, metsulfuron and carfentrazone for satisfactory control of complex weed flora in wheat.

MATERIALS AND METHODS

An experiment to evaluate the bioefficacy of pinoxaden 5 EC in combination with broad-leaved weeds in wheat was conducted during *Kharif* and *Rabi* seasons of 2006-07 and 2007-08, at Agronomy Research Area of CCS Haryana Agricultural University, Hisar. The experimental soil was sandy loam (Typic Ustochrepts) with 61% sand, 22.1% silt and 19.1% clay, medium in fertility with 0.29% organic carbon and pH of 8.2. Wheat variety '*PBW-343*' was drilled on November 14, 2006 and November 5, 2007 during first and second year respectively, by FIRBS method, in a plot size of 6.0 x 2.1 m^2, by using seed rate of 87.5 kg/ha. The study was arranged in randomized block

design and was replicated thrice. Recommended dose of fertilizers and irrigations were applied uniformly. The treatments comprising of pinoxaden 5 EC at 45 g/ha alone and in combination with metsulfuron, carfentrazone or 2,4-D as tank mixture, sequential application of these broad-leaved herbicides before or after pinoxaden use at recommended rates were applied at 40 DAS by flat fan nozzle delivering 375 l/ha volume. Observations for weed population and their dry matter accumulation were recorded at 30 DAT with the help of random quadrate (0.5 x 0.5 m) at four places in a plot and then converted into per m^2. This data was subjected to square root ($\sqrt{x + 1}$) transformation to normalize their distribution before analysis. Data on per cent visual control by herbicides on 0-100 scale, yield attributes and grain yield was recorded at harvest which was statistically analyzed using analysis of variance.

RESULTS AND DISCUSSION

Experimental field was infested with natural population of grassy (69%) and broad-leaved weeds (31 %) during both the years. The dominant weeds were little seed canary grass (*P. minor*) among grassy weeds and common lambs quarters (*Chenopodium album*), yellow sweet clover (*Melilotus indica*) and golden dock (*Rumex dentatus*) were present as broad-leaved weeds.

Effect on weeds

The density and dry mater of weeds decreased significantly due to different herbicide treatments as compared to untreated check at 30 days after treatment (Table 1). Although pinoxaden at 45 g/ha provided excellent control (95-100%) of grassy weeds but did not show any efficacy against broad-leaved weeds as shown by density and biomass of weeds. The tank mix application of pinoxaden with broad-leaved herbicides proved significantly effective in reducing density and dry weight of weeds and gave 85-100 % control of broad-leaved and 100% control of *P. minor*. This is in conformity with the findings of Yadav *et al.* (2009). Tank mixture of 2,4-D with pinoxaden did not result any antagonistic effect as anticipated. Hence pinoxaden can safely be used as tank mix with 2,4-D, metsulfuron or carfentrazone with no loss of herbicide efficacy.

Effect on crop

Tank mixing of carfentrazone with pinoxaden although caused injury in terms of yellowing of tips but injury symptoms disappeared within 15 days after spray and did not result in any detrimental effect on grain yield of wheat. Number of spikes, plant height, and number of grains per panicle and grain yield were significantly affected due to various herbicide treatments. Maximum Number of spikes per m.r.l. with tank mixture of pinoxaden + metsulfuron were 151 and 188, during 2006-07 and 2007-08, respectively and were statistically at par with all combinations of pinoxaden + 2,4-D, pinoxaden+ carfentrazone, or their sequential applications with pinoxaden and weed free treatment. Number of grains per panicle was maximum (49) in weed free, which were sta-

Table 1. Effect of herbicidal treatments on density and per cent control of weeds in wheat

Treatment	Dose (g/ha)	Density of *P. minor* (no./m^2) at 30 DAT		Dry wt. of weeds (g/m^2) at 30 DAT		Visual control (%)				Crop injury at 10 DAT	
						Grassy weeds		BLWs			
		2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Pinoxaden	45	1.4 (1)	1 (0)	12.9	17.6	95	100	0	0	0	0
Pinoxaden + carfentrazone-ethyl	45 + 20	1(0)	1(0)	3.5	3.2	100	100	85	87	5	3
Pinoxaden + metsulfuron-methyl	45 + 4	1(0)	1(0)	2.1	0	100	100	98	100	0	0
Pinoxaden + 2,4-D	45 +500	1(0))	1(0)	2.9	3.1	100	100	90	93	0	0
Carfentrazone-ethyl *fb* pinoxaden	20 and 45	1(0)	2(3)	4.5	4.8	100	89	87	90	0	0
Metsulfuron-methyl *fb* pinoxaden	4 and 45	1(0)	1(0)	0	0	91	100	92	100	0	0
2,4-D *fb* pinoxaden	500 and 45	1 (0)	1.4(1)	2.8	3.5	100	93	94	90	0	0
Pinoxaden *fb* Carfentrazone-ethyl	45 and 20	1.7(2)	1(0)	3.3	2.9	91	100	90	90	0	0
Pinoxaden *fb* metsulfuron-methyl	45 and 4	1(0)	1(0)	0	1.7	100	100	100	98	0	0
Pinoxaden *fb* 2,4-D	45 and 500	1(0)	1(0)	3.3	2.6	100	100	91	94	0	0
Carfentrazone-ethyl	20	5.1(25)	5.4(28)	19.6	24.6	0	0	92	90	0	0
Metsulfuron-methyl	4	6.4(40)	6.6(43)	27.7	32.8	0	0	95	100	0	0
2,4-D	500	5.7(32)	6.1(36)	24.5	29.4	0	0	94	93	0	0
Weedy	-	5.9(34)	6.5(41)	47.8	52.6	0	0	0	0	0	0
Weed-free	-	0(1)	0(1)	0	0	100	100	100	100	0	0
LSD (P=0.05)		0.42	0.61	1.8	1.6	2.1	1.4	2.5	5.3	-	-

Table 2. Effect of herbicidal treatments on yield attributes of wheat

Treatment	Dose (g/ha)	Number of spikes per meter row length		Grains/spike		1000-grain weight (g)		Grain yield (t/ha)	
		2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Pinoxaden	45	146	180.3	49.7	51.0	43.1	42.7	4.26	4.55
Pinoxaden + carfentrazone-ethyl	45 + 20	150.0	186.0	50.0	50.0	43.2	43.3	4.65	4.82
Pinoxaden + metsulfuron-methyl	45 + 4	151.3	188.2	50.0	52.0	43.5	44.3	4.69	4.86
Pinoxaden + 2,4-D	45 + 500	149.7	186.6	49.3	50.0	43.3	44.0	4.64	4.80
Carfentrazone-ethyl *fb* pinoxaden	20 and 45	153.7	187.6	49.7	502	43.2	43.5	4.51	4.64
Metsulfuron-methyl *fb* pinoxaden	4 and 45	153.3	188.0	50.3	51.0	43.2	43.6	4.59	4.78
2,4-D *fb* pinoxaden	500 and 45	149.0	185.7	51.0	50.0	43.2	42.9	4.56	4.82
Pinoxaden *fb* Carfentrazone-ethyl	45 and 20	152.0	185.0	50.0	50.3	43.1	42.7	4.59	4.72
Pinoxaden *fb* metsulfuron-methyl	45 and 4	150.0	186.0	50.7	50.7	43.1	43.3	4.66	4.86
Pinoxaden *fb* 2,4-D	45 and 500	149.0	184.0	49.0	49.0	43.4	43.9	4.60	4.79
Carfentrazone-ethyl	20	122.0	170.0	47.0	50.0	43.0	43.7	3.70	3.82
Metsulfuron-methyl	4	123.7	169.7	47.2	50.0	43.5	43.6	3.83	3.95
2,4-D	500	121.0	168.7	48.0	48.7	42.4	42.9	3.65	3.84
Weedy	-	121.7	167.7	48.3	47.7	43.0	43.0	2.93	3.26
Weed free	-	150.1	188.0	51.0	52.7	43.7	43.8	4.67	4.88
LSD(P=0.05)		7.4	7.9	2.4	2.1	NS	0.9	0.48	0.24

tistically at par with all combinations of pinoxaden + metsulfuron and pinoxaden alone at both the application rates.

In 2006-07, maximum grain yield (4.69 t/ha) was recorded with use of pinoxaden + metsulfuron at 45+ 4 g/ ha which was at par with weed free (4.67 t/ha) and all combinations of pinoxaden and broad-leaved herbicides (Table 2). Similarly in 2007-08, maximum grain yield (4.88 t/ha) was recorded in weed free followed by pinoxaden +metsulfuron (4.86 t/ha), pinoxaden + carfentrazone (4.82 t/kg) and pinoxaden+ 2,4-D (4.80 t/ha). Presence of weeds throughout the growing season brought about 37.2 and 33.1 % reduction in grain yield as compared to weed-free check during 2006-07 and 2007-08, respectively.

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