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Evaluation of Pinoxaden in Combination with 2, 4-D against Complex Weed Flora in Barley

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In south-western Haryana, infestation of *Avena ludoviciana* is increasing at an alarming rate in barely crop due to adoption of improved production technology involving high inputs like fertilizers and irrigation. In north-eastern Haryana, crop is mainly grown after rice and mainly infested with *P. minor* alongwith broadleaf weeds such as *Rumex dentatus, Anagallis arvensis* and *Chenopodium album.* So, there is urgent need for broad spectrum herbicides, which can provide effective control of both grassy and broadleaf weeds in barely crop.

A new post-emergence herbicide pinoxaden @ 40-60 g/ha is very effective against *A. ludoviciana* and resistant population of *P. minor* without any phytotoxicity to barley crop (Singh and Punia, 2007; Chhokar *et al.*, 2008). For broadleaf weeds, 2, 4-D alone is being widely used, but for control of isoproturon resistant population of *P. minor* and *A. ludoviciana* major grassy weeds, certain farmers have to use both herbicides sequentially but it involves application in two rounds, resulting in enhancing the cost. Keeping this in view, the present investigation was planned to study the efficacy of pinoxaden alone and in combination with 2, 4-D applied at different rates and growth stages against weeds in barley.

An experiment to evaluate the bioefficacy of pinoxaden 5 EC in combination with 2,4-D in barley was conducted at Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Cotton Research Station, Sirsa (India) during winter (**rabi**) season of 2008-09. The experimental soil was sandy loam with 62.4% sand, 19.4% silt and 18.2% clay, medium in fertility with 0.40% organic carbon and pH of 7.25. Barley variety BH-393 was drilled on November 21, 2008 in plot size of 6.6 x 4.5 m^2, by using seed rate of 87.5 kg/ha. The study was arranged in randomized block design and was replicated thrice. The treatments comprising pinoxaden (5 EC) at 40, 45 and 50 g/ha alone and in combination with 2,4-D at 500 g/ha either as tank mixture or their sequential application seven days before or after pinoxaden use were applied at 35 and 42 DAS by flat fan nozzle delivering 375 l/ha volume. Observations for weed population and their dry matter accumulation were recorded at 90 DAS with the help of random quadrat (0.5 x 0.5) at two places in a plot and then converted into per m^2. These data were 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 were recorded and data on yield attributes and grain yield of barley were recorded at harvest which were statistically analyzed using analysis of variance.

The experimental field was infested with natural population of grassy (51%) and broadleaf weeds (49%). The dominant weeds were little seed canary grass (*Phalaris minor* Retz.) and *Avena ludoviciana* among grassy weeds and *Chenopodium album* L. (22%), *Melilotus indica* (8%) and other weed species (19%) were present as broadleaf weeds at 30 DAS.

The density and dry matter of weeds decreased significantly due to different herbicide treatments as compared to untreated check at 90 DAS. Although pinoxaden at all the application rates provided excellent control of grassy weeds but did not show any efficacy against broadleaf weeds as shown by density and dry weight of weeds (Table 1). 2, 4-D at 500 g/ha gave 80% control of broadleaf weeds. Tank mix application of pinoxaden with 2, 4-D in various combinations proved significantly effective in reducing density and biomass of weeds and gave 75-79% control of broadleaf and 89-93% control of grassy weeds. Sequential application of 2, 4-D either seven days before or after use of pinoxaden also provided 90-95% control of grassy and 76-83% control of broadleaf weeds without any phytotoxic effect on crop.

Number of effective tillers, spike length, plant height, number of grains per spike and grain yield were significantly affected due to various herbicide treatments. Maximum number of effective tillers/m^2 (356) was recorded with pinoxaden+2,4-D at 45+500 g/ha which was statistically at par with weed free and significantly higher than 2,4-D alone and weedy check treatments. Number of grains per spike, spike length and plant height

Table 1. Effect of different treatments on weed density, dry weight and per cent control of weeds

Treatments	Dose (g/ha)	Weed density/m^2 at 90 DAS				Weed dry weight (g/m^2) at 90 DAS		Visual weed control (%)	
		P. minor	*Avena ludoviciana*	*C. album*	*Melilotus indica*	Grassy	BLW	Grassy	BLW
Pinoxaden	40	1.41 (1.0)	1.13 (0.3)	4.72 (21.3)	2.58 (5.7)	6.0	42.3	90	00
Pinoxaden	45	1.27 (0.27)	1.27 (0.7)	4.58 (20.0)	2.64 (6.0)	6.6	41.2	92	00
Pinoxaden	50	1.0 (0.0)	1.0 (0.0)	4.43 (18.7)	2.51 (5.3)	6.3	45.0	93	00
Pinoxaden+2, 4-D	40+500	1.41 (1.0)	1.27 (0.7)	1.41 (1.0)	1.27 (0.7)	7.0	7.5	89	77
Pinoxaden+2, 4-D	45+500	1.0 (0.0)	1.62 (1.7)	1.0 (0.0)	1.41 (1.0)	6.9	7.3	92	75
Pinoxaden+2, 4-D	50+500	1.27 (0.7)	1.41 (1.0)	1.63 (1.7)	1.0 (0.0)	7.0	7.1	93	79
2, 4-D fb pinoxaden	500 & 40	1.41 (1.0)	1.52 (1.3)	1.0 (0.0)	1.13 (03)	7.4	6.9	95	83
2, 4-D fb pinoxaden	500 & 45	1.41 (1.0)	1.13 (0.3)	1.0 (0.0)	1.0 (0.0)	6.4	6.8	94	80
2, 4-D fb pinoxaden	500 & 50	1.0 (0.0)	1.0 (0.0)	1.7 (2.0)	1.27 (0.7)	6.1	7.0	96	77
Pinoxaden fb, 2, 4-D	40 & 500	1.27 (0.7)	1.27 (0.7)	1.0 (0.0)	1.41 (1.0)	6.4	6.2	90	81
Pinoxaden fb, 2, 4-D	45 & 500	1.0 (0.0)	1.13 (0.3)	1.0 (0.0)	1.0 (0.0)	5.9	6.3	92	80
Pinoxaden fb, 2, 4-D	50 & 500	1.0 (0.0)	1.0 (0.0)	1.27 (0.7)	1.52 (1.3)	5.9	6.5	93	76
2, 4-D	500	5.03 (24.3)	4.20 (16.7)	1.0 (0.0)	1.38 1.0)	111.4	6.3	00	80
Weedy check	-	5.23 (26.4)	4.09 (15.8)	4.79 (22.0)	2.59 (5.8)	119.3	44.6	00	00
Weed free	-	1.0 (0.00)	1.0 (0.0)	1.0 (0.0)	1.0 (0.0)	0.0	0.0	100	100
LSD (P=0.05)	-	0.72	0.85	0.87	0.64	2.06	2.12	-	-

were also maximum with the use of pinoxaden and 2, 4-D either as tank mixture or used sequentially. All the herbicide treatments registered significantly higher crop yield over weedy check. Maximum grain yield (5134 kg/ha) was recorded in pinoxaden + 2, 4-D at 50 + 500 g/ha which was statistically at par with weed free and all treatments involving pinoxaden and 2, 4-D (Table 2). Better crop yields with tank mixtures of pinoxaden with

Table 2. Effect of weed control treatments on grain yield and yield attributes of barley

Treatments	Dose (g/ha)	Plant height (cm)	No. of effective tillers/m^2	No. of grains/spike	Spike length (cm)	Grain yield (kg/ha)
Pinoxaden	40	96	337	50	7.7	4651
Pinoxaden	45	96	339	50	7.8	4654
Pinoxaden	50	95	337	49	7.7	4677
Pinoxaden+2, 4-D	40+500	98	349	53	8.0	5092
Pinoxaden+2, 4-D	45+500	97	356	52	7.8	5099
Pinoxaden+2, 4-D	50+500	98	350	52	7.9	5134
2, 4-D fb pinoxaden	500 & 40	96	352	52	8.1	5049
2, 4-D fb pinoxaden	500 & 45	98	353	52	8.2	4990
2, 4-D fb pinoxaden	500 & 50	97	356	53	8.2	5099
Pinoxaden fb, 2, 4-D	40 & 500	97	354	52	8.1	5121
Pinoxaden fb, 2, 4-D	45 & 500	98	356	51	8.0	4967
Pinoxaden fb, 2, 4-D	50 & 500	96	351	52	7.8	5121
2, 4-D	500	94	332	48	7.3	4257
Weedy check	-	93	311	46	7.0	3807
Weed free	-	98	357	52	8.1	5160
LSD (P=0.05)		NS	6.32	4.0	0.50	280

NS–Not Significant.

2, 4-D or sequential application of both the herbicides was due to excellent control of grassy as well as broadleaf weeds, which resulted in reduced weed competition with crop. Presence of weeds throughout the growing season brought about 26.3% reduction in grain yield as compared to weed free.

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