Indian Journal of Weed Science **49**(2): 136–138, 2017
DOI: 10.5958/0974-8164.2017.00036.3

Optimization rate of pinoxaden + clodinafop-propargyl for weed control in wheat

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Received: 12 April 2017; Revised: 2 June 2017

ABSTRACT

A field experiment was conducted during 2011-12 and 2012-13 at G.B. Pant University of Agriculture &Technology, Pantnagar to study the effect of different rates of pre-mix of pinoxaden 2.53% + clodinafop-propargyl 2.53% on population and growth of weeds and grain yield of wheat. Major weed species identified in the experiment were *Phalaris minor, Avena* spp., *Chenopodium album, Anagallis arvensis, Polygonum plebeium, Melilotus indica, Coronopus didymus* during both the years. The lowest density and biomass of grassy weeds were recorded with pinoxaden 2.53% + clodinafop-propargyl 2.53% at 60 g/ha. However, it was ineffective against broad-leaf weeds. Maximum grassy weed control efficiency (100%) was observed with pinoxaden + clodinafop-propargyl at 60 g/ha closely followed by its lower dose applied at 50 g/ha and pinoxaden at 50 g/ha. Pre-mix of pinoxaden 2.53% + clodinafop-propargyl 2.53% at 60 g/ha produced highest grain yield (4.5-4.6 t/ha). Uncontrolled weeds caused 55.7 and 52.2% reduction in grain yield of wheat when compared with weed free conditions during 2011-12 and 2012-13.

Key words: Clodinafop-propargyl, Optimization rate, Pinoxaden, Weed managment, Wheat

Wheat (*Triticum aestivum* L.) is the second most important food grains next to rice in India in terms of area and production. It occupies an area of 29.6 mha with annual production of 88.94 mt and productivity of 2.87 t/ha (Anonymous 2015). As a result of ever increasing population, demand for wheat will also be increased. Therefore, it is necessary to increase the wheat production and productivity to provide food to the increasing population. Weeds cause substantial losses in yield and quality of wheat crop. In wheat, weeds alone account for 10 to 82% yield losses depending upon weed species, severity and duration of weed infestation and climatic conditions (Jat *et al.* 2003). Earlier in India, isoproturon was the most effective and economical for controlling grassy weeds in wheat but its continuous and sub optimum use led to development of herbicidal resistance particularly in *Phalaris minor* in some parts of Punjab and Haryana. In order to tackle the resistance problem, some alternative herbicides like fenoxaprop-p-ethyl, clodinafop propargyl, pinoxaden and sulfosulfuron, have been recommended for weed control in irrigated wheat (Dhaliwal *et al.* 2003). Recently many new molecules have been developed by different agro-chemical industries. However, their efficacy needs to be tested. A readymade mixture of pinoxaden and clodinafop-propargyl has been developed to provide speedy and effective control of *Phalaris minor* and *Avena ludoviciana* when applied as post-emergence in wheat crop. Every herbicide has an optimum dose, under a set of environment, for effective control of weeds. Under or over dose of herbicide is not desirable as under dose may be less effective and may facilitate development of resistance in weeds, while over dose may result into phytotoxicity. Keeping the above points in view, the present study was carried out to study the combined use of two chemicals.

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MATERIALS AND METHODS

An experiment was conducted during *Rabi* seasons 2011-12 and 2012-13 at Pantnagar to see the effect of pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% against weed flora in wheat. The soil of the experimental field was clay loam in texture, medium in organic carbon (0.67%), available phosphorus (29.6 kg/ha) and potassium (176.4 kg/ ha) with pH 7.2. Eight treatments consisted of readymade mixture of pinoxaden 2.53% + clodinafop propargyl 2.53% in three different rates *i.e.* 40, 50 and 60 g/ha, pinoxaden 50 g/ha, clodinafop propargyl 60 g/ha and fenoxaprop-p-ethyl 120 g/ha along with weed free and untreated check. Experiment was laid out in randomized block design with three replications. Wheat cultivar *"UP2565'* was sown on 9 Dec, 2011 and 22th Nov, 2012 using seed rate of 100 kg/ha and fertilized with 120 kg N, 60 kg P_2O_5 and 40

kg K_2O. Herbicides were applied by using a knapsack sprayer fitted with flat-fan nozzle with water volume of 500 l/ha. Observations on weed density, dry weight of weeds were taken at 90 days after sowing. A quadrate of 0.25 m^2 was placed randomly and weed species within the quadrate were identified and their number was counted species wise. The collected weeds were first dried in the sun and then in an electric oven for at 70±2 °C till constant dry weight. Dry matter of weeds was recorded and expressed in g/m^2.The data on weed density and weed biomass were analyzed after subjecting to square root transformation for comparison. Weed control efficiency was calculated based on control of grassy weeds only.

RESULTS AND DISCUSSION

Effect on weeds

Wheat field was infested with both grassy and broad-leaved weeds during both the years. However, the flora was dominated by grassy weeds *Phalaris minor* and *Avena ludoviciana. Chenopodium album, Rumex spinosus, Coronopus didymus, Melilotus alba* and *Polygonum plebeium* were among broad-leaf weeds. Among the herbicidal treatments, post-emergence application of pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% 60 g/ha resulted in excellent control of *Phalaris minor* and *Avena ludoviciana* (**Table 1**). This treatment was found at par with pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% at 50 g/ ha and pinoxaden at 50 g/ha. The effective control of *Phalaris minor* with clodinafop and pinoxaden has also been reported earlier (Chhokar *et al.* 2007). . Pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% at all tested doses found to be ineffective against broad-leaf weeds.

Biomass and weed control efficiency (WCE %)

Among the treatments, significantly less dry weight of grassy weeds was observed in pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% at 60 g/ha at 90 DAS which was at par with its lower dose at 50 g/ha and weed free treatment. Maximum weed control efficiency (100 & 100 %), calculated on the basis of control of grassy weeds only was also recorded with pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% at 60 g/ha at 90 DAS followed by its lower dose applied at 50 g/ha and pinoxaden at 50 g/ha (**Table 2**) .

Effect on yield

There were 49.5 and 45.6% yield reduction under unweeded plot over pre-mix of pinoxaden + clodinafop propargyl at 60 g/ha during 2011-12 and 2012-13 respectively (**Table 3**). Losses in grain yield of wheat due to uncontrolled weeds have also been reported to the extent of 10 to 50% by Mukhopadhyay and Brar (1980), 31.8 to 54.2% by Kumar (1993) and Meena (1996) at Pantnagar and 23.9 to 32.6% by Duary and Yaduraju (2005) from New Delhi. The maximum grain yield was recorded from the weed free plot (5.2 and 5.2 t/ha). Among the herbicidal treatments, pre-mix of pinoxaden+ clodinafop propargyl at 60 g/ha produced the highest yield which was closely followed by pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% at 50 g/ha, clodinafop-propargyl at 60 g/ha and pinoxaden at 50 g/ha. Yield attributes, *viz.* number of grains/spike, spike length and 1000-grain weight in plots treated with this pre-mix at 60 g/ha was also at par with weed free condition. The highest number of spikes/m^2 (372 and 366), number of grains/spike (42.7 and 42.3), spike length (12.4 and 12.1 cm) and

Table 1. Effect of pre-mix of pinoxaden + clodinafop propargyl on density of weeds at 90 days after sowing during 2011-12 and 2012-13

Treatment	Dose (g/ha)	Weed density (no./m^2)							
		P.minor		*Avena* spp.		BLWs		Total	
		2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Pinoxaden 2.53% + clodinafop propargyl 2.53%	40	2.82(7)	2.49(5)	2.43(5)	2.75(7)	9.22(84)	9.93(98)	9.83(96)	10.51(110)
Pinoxaden 2.53% + clodinafop propargyl 2.53% EC	50	1.90(3)	1.00(0)	1.00(0)	1.41(1)	8.52(72)	9.98(99)	8.42(73)	9.98(100)
Pinoxaden 2.53% + Clodinafop propargyl 2.53% EC	60	1.00(0)	1.00(0)	1.00(0)	1.00(0)	8.05(64)	9.78(95)	7.80(64)	9.74(95)
Pinoxaden	50	1.41(1)	1.41(1)	1.90(3)	1.82(3)	8.66(74)	10.03(100)	8.80(78)	9.98(104)
Clodinafop propargyl	60	2.10(4)	1.82(3)	2.10(4)	2.49(5)	8.44(71)	9.73(94)	8.87(79)	10.11(102)
Fenoxaprop-p-ethyl	120	3.00(8)	2.75(7)	2.43(5)	2.49(5)	8.87(78)	9.84(96)	9.45(90)	10.39(108)
Weed free	-	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)
Untreated control	-	9.00(80)	9.78(95)	3.58(12)	4.10(16)	9.94(98)	9.84(96)	13.78(190)	14.37(207)
LSD (p=0.05)		0.90	0.76	0.75	0.89	0.90	0.44	2.5	2.14

Figures in parentheses are means of original values. Data are subjected to square root transformation.

Table 2. Effect of pre-mix of pinoxaden + clodinafop propargyl on weed biomass at 90 days after sowing during 2011-12 and 2012-13

Treatment	Dose (g/ha)	Weed biomass (g/m^2)						WCE (%)	
		Grassy		BLWs		Total			
		2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Pinoxaden 2.53% + Clodinafop propargyl 2.53% EC	40	4.04(15)	4.25(17)	6.89(47)	7.61(57)	7.93(62)	8.66(74.4)	92.5	92.1
Pinoxaden 2.53%+ Clodinafop propargyl 2.53% EC	50	1.19(1)	1.45(2)	6.75(45)	7.68(60)	6.79(46)	7.80(61.3)	99.5	99.0
Pinoxaden 2.53%+ Clodinafop propargyl 2.53% EC	60	1.00(0)	1.00(0)	6.12(38)	7.26(52)	6.19(38)	7.39(52.3)	100.0	100.0
Pinoxaden	50	2.10(4)	2.55(6)	6.06(37)	7.67(59)	6.37(40)	8.08(64.9)	98.0	97.0
Clodinafop propargyl	60	3.05(8)	3.56(12)	6.14(37)	7.38(54)	6.79(46)	8.14(65.5)	96.0	94.1
Fenoxaprop-p-ethyl	120	4.08(16)	4.36(18)	6.08(36)	7.53(56)	7.26(52)	8.72(74.1)	92.1	91.1
Weed free	-	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)	1.00(0)	100.0	100.0
Untreated control	-	14.24(202)	14.72(216)	7.31(53)	7.46(55)	15.99(255)	16.49(271)	0	0
LSD (P=0.05)		0.38	0.78	1.53	1.74	1.30	1.49	-	-

Figures in parentheses are means of original values. Data are subjected to square root transformation

Table 3. Effect of pre-mix of pinoxaden + clodinafop propargyl on yield attributing characters and yield of wheat during 2011-12 and 2012-13

Treatment	Dose (g/ha)	No. of spikes/m^2		Spike length (cm)		No. of grain/spike		1000-grain weight (g)		Yield (t/ha)	
		2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13
Pinoxaden 2.53%+ clodinafop propargyl 2.53% EC	40	308	297	11.3	11.0	38.7	38.3	45.7	45.5	4.1	4.1
Pinoxaden 2.53% + clodinafop propargyl 2.53% EC	50	342	327	11.7	11.6	40.7	40.3	48.5	48.1	4.6	4.5
Pinoxaden 2.53% + clodinafop propargyl 2.53% EC	60	347	330	12.0	11.8	41.5	40.9	48.9	48.5	4.6	4.5
Pinoxaden	50	336	322	11.5	11.2	39.7	39.3	46.8	46.5	4.5	4.4
Clodinafop propargyl	60	334	320	11.7	11.5	40.3	39.7	47.8	47.5	4.5	4.4
Fenoxaprop-p-ethyl	120	310	300	11.0	10.9	39.3	38.7	46.0	45.8	4.3	4.2
Weed free	-	372	366	12.4	12.1	42.7	42.3	48.9	48.8	5.2	5.2
Untreated control	-	200	204	10.5	10.8	35.9	36.3	44.8	45.1	2.3	2.5
LSD (p=0.05)		7.13	6.96	NS	NS	1.79	1.57	0.48	0.46	672.4	0.3

1000-grain weight (48.9 and 48.8 g) were observed under weed free condition during 2011-12 and 2012-13 respectively. The higher grain yield and yield attributing characters in pre-mix of pinoxaden + clodinafop propargyl at 60 g/ha was attributed to low weed density and weed biomass, which might have caused less weed competition with wheat resulted in the production of higher yield attributes which was reflected in higher yield.

It can be concluded that application of pre-mix of pinoxaden 2.53% + clodinafop propargyl 2.53% applied at 50-60 g/ha at 35 days after sowing is effective for the control of *Phalaris minor* and *Avena ludoviciana* and also produce higher grain yield of wheat.

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