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Research Article

Evaluation of Clodinafop-propargyl 15 WDG as a New Formulation against Weeds in Wheat

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Abstract

A field experiment was conducted during *rabi* season of 2014-15 and 2015-16 to evaluate the new formulation of clodinafop-propargyl 15%WDG against grassy weeds in wheat. During both the years of study, clodinafop 15WDG at 60, 90 & 120 g/ha provided 80 to 100% control of grassy weeds (*P. minor* and *A. ludoviciana*) comparative to Topik brand of clodinafop used at 60 g/ha, however, lower dose of clodinafop 15WDG 30g/ha was not effective in controlling the grassy weeds. At higher dose of 120 g/ha, clodinafop 15WDG caused slight phytotoxicity on wheat which was temporary and phytotoxic effects disappeared within 30 days after herbicide application. Wheat yield and yield attributes were at par among the treatments of clodinafop 15WDG at 60, 90 & 120 g/ha with Topik brand of clodinafop used at 60 g/ha. There was no residual toxicity on succeeding crop of mung bean and sorghum crops was observed during the two years of study.

Keywords: clodinafop-propargyl, WDG, herbicide, weeds, wheat, residual toxicity

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Introduction

Wheat is an important crop of Haryana grown on about 2.2 m ha area in the state. It is grown under rice - wheat, cotton – wheat, pearl millet- wheat and clusterbean/mung-bean-wheat crop sequences in different regions of the state. Weed infestation is one of the major constraints in sustainable wheat production. The losses caused by weed vary depending on the weed species, their density, environmental factors, farm practices, cropping systems etc. [1 & 2]. *Phalaris minor* and *Avena ludoviciana* are the two most problematic grassy weeds responsible for reducing productivity of wheat [3]. Early detection of these two weeds from wheat is very tedious, though, herbicides are efficient in their selective kill. *P. minor* evolved resistance against isoproturon herbicide in early 90's [4] and its efficacy against *A. ludoviciana* is poor if applied at 30-35 DAS. So, alternate herbicides *viz*. clodinafop, sulfosulfuron, fenoxaprop were recommended for the control of resistant *P. minor* and other grassy weeds [5]. Clodinafop in different concentrations is being used widely by wheat grower for control of grasses in north western Indian plains [6] but clodinafop 15 WDG (Water Dispersible Granules) for grassy weeds control have not been evaluated. In the present experiment, a new formulation WDG of clodinafop was evaluated against grassy weeds in wheat and compared with Topik brand of clodinafop already recommended for Haryana state.

Materials and Methods

To evaluate the bio-efficacy and phytotoxicity of herbicide clodinafop - propargyl WCPL 15% WDG (Willowood Chemicals Pvt. Ltd.) against grassy weeds in wheat, a field experiment consisting of different treatments (**Table 1**) replicated thrice was conducted in a randomized block design at CCS HAU, Hisar during *rabi* 2014-2015 and 2015-16. Soil of the experimental field was sandy loam in texture, low in available N, medium in P_2O_5 and high in available K_2O, with slightly alkaline in reaction. Wheat variety WH 1105 was sown on 19th November, 2014 whereas variety DPW 621-50 was sown on 28.11.2015 using a seed rate of 100 kg/ha keeping row-row distance of 20 cms, in a plot size of 10 m x 3 m. During both the years, all the herbicidal treatments were applied at 40 DAS with the help of knap sack sprayer fitted with flat fan nozzle using a spray volume of 400 liters/ha.

Table 1 Effect of different weed control treatments on grassy weed population in wheat

Treatment	Dose (g /ha)	Density of grassy weeds (No./m^2) Before spray		Density of grassy weeds (No./m^2) At harvest		Dry weight of grassy weeds (g/m^2) At harvest		WCE (%) at harvest	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
WCPL 15WDG	200	6.1(36)	6.5(41)	4.1(16)	4.4(18)	15.5(240)	15.7(246)	40	39
WCPL 15WDG	400	6.0(35)	6.3(39)	1.7(2)	2.2(4)	6.9(47)	8.1(65)	88	84
WCPL 15WDG	600	5.9(34)	6.4(40)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	100	100
WCPL 15WDG	800	6.1(36)	6.3(39)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	100	100
Clodinafop (Topik)	400	6.2(37)	6.5(41)	1.7(2)	2.0(3)	7.4(54)	7.7(59)	86	85
HW	15 &30 DAS	3.7(13)	3.9(14)	3.7(13)	3.9(14)	14.9(221)	15.1(228)	45	43
Weedy check	-	6.0(35)	6.4(40)	6.1(36)	6.4(40)	19.9(396)	20.1(403)	0	0
Weed free	-	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	1.0(0)	100	100
CD at 5%		0.67	8	0.68	0.72	4.1	4.3	-	-

Original data given in parenthesis was subjected to square root (√x+1) transformation before analysis

Weed population and their dry weight was recorded periodically (Table 1 and **Table 2**). The dry weight of weeds was recorded (sun dried) for the counted weeds from each plot and then kept them in oven at 70^0 C till constant weight was achieved. Based on dry wt. of grassy weeds (*P. minor* and *A. ludoviciana*), weed control efficiency (WCE) was calculated by the following formula:

$$\text{WCE (\%)} = \frac{(\text{Dry wt of } \textit{grassy} \text{ weeds in untreated plot} - \text{Dry wt of } \textit{grassy} \text{ weeds in treated plot})}{\text{Dry wt of } \textit{grassy weeds} \text{ in untreated plot}}$$

Table 2 Effect of various weed control treatments on wheat plant height and crop phytotoxicity (0-100 scale)

Treatment	Dose (g /ha)	Yellowing (Days after treatment)				Stunting (Days after treatment)				Necrosis (Days after treatment)				Plant height (cm) at harvest	
		15 DAT		30 DAT		15 DAT		30 DAT		15 DAT		30 DAT			
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
WCPL 15WDG	200	0	0	0	0	0	0	0	0	0	0	0	0	96.6	102.3
WCPL 15WDG	400	10	10	0	0	0	0	0	0	0	0	0	0	96.3	102.1
WCPL 15WDG	600	20	20	0	0	0	0	0	0	0	0	0	0	95.7	100.1
WCPL 15WDG	800	20	20	0	0	0	0	0	0	0	0	0	0	94.8	99.3
Clodinafop (Topik)	400	0	0	0	0	0	0	0	0	0	0	0	0	96.5	103.1
HW	15 & 30 DAS	0	0	0	0	0	0	0	0	0	0	0	0	97.3	102.6
Weedy check	-	0	0	0	0	0	0	0	0	0	0	0	0	94.4	101.4
Weed free	-	0	0	0	0	0	0	0	0	0	0	0	0	97.6 NS	103.3 NS

Observations were recorded for crop injury and percent weeds control on a 0-100 scale (0=no effect and 100=complete mortality). The field was infested with natural population of *Phalaris minor*, *Avena ludoviciana* and few other broad leaf weeds. Yield parameters and crop yield was recorded at harvest.

To observe the residual toxicity of clodinafop WCPL 15WDG on succeeding crop, after harvest of wheat crop mung bean was sown during the 1st year and sorghum was sown during the 2nd year of study in the plots treated with wheat herbicides without disturbing the original layout. Both the crops were raised as per recommended package of practices for Haryana state excepting herbicidal treatments in wheat.

Results and Discussion

The experimental area was dominated by grassy weeds which constituted 80% of the total weed population in the experimental area. Among grassy weeds, *P. minor* and *A. ludoviciana* were the dominant weed and *P. minor* constituted more than 90% of the total grassy weed population. Among broad leaf weeds, *Chenopodium album*, *Rumex dentatus*, *Melilotus indica* and *Coronopus didymus* were the main weeds which constituted about 10% of the total weed population in the field.

Data presented in Table 1 revealed that during both the years of study, lower dose (30 g/ha) of clodinafop WCPL 15WDG was not effective in arresting growth of grassy weeds (*P. minor* and *A. ludoviciana*) and provided less than 50% control of the grassy weeds but its higher doses i.e. 60, 90 & 120 g/ha provided 80 to 100% control of grassy weeds (*P. minor* and *A. ludoviciana*) as shown by density of grassy weeds, WCE of different treatments and weed mortality (percent) of grassy weeds (Table 1).

More than 90 percent control of grassy weeds by clodinafop-propargyl at 60 g/ha was observed [7]. *P. minor* was controlled effectively due to application of clodinafop-propargyl at 60 g/ha to that of 30 g/ha was reported [8]. So, clodinafop WCPL 15 WDG, a new formulation of clodinafop was equally effective to already recommended Topik brand in arresting growth of grassy weeds, particularly *P. minor* and *A. ludoviciana*, in wheat. Maximum dry weight of weeds was recorded in weedy check plots, which was significantly higher over other treatments. No crop phytotoxicity in terms of yellowing/chlorosis, stunting and necrosis was recorded at 15, 30 and 60 DAT (days after treatment) due to higher dose of clodinafop WCPL 15WDG (90 & 120 g/ha) except at 120 g/ha where slight phytotoxicity was observed in wheat plants but the effects were temporary which disappeared with in thirty days after herbicide application (Table 2). Higher doses of clodinafop at 90 & 120 g/ha did not harm the wheat growth and yield [8 & 9].

Number of effective tillers, test weight and grain yield (**Table 3**) varied significantly among different treatments but it was at par among different doses of clodinafop WCPL 15 WDG except 30 g/ha during both years. Grain yield and number of effective tillers/mrl were at par among the treatments of clodinafop WCPL 15 WDG at 60, 90 & 120 g/ha with Topik brand of clodinafop used at 60 g/ha (Table 3). Maximum wheat grain yield was recorded in weed free plots during during both the years of study 2014-15 and 2015-16, respectively. Wheat grain yield in plots sprayed with clodinafop WCPL 15WDG 120 g/ha was at par with all other herbicidal treatments except clodinafop at 30 g/ha and weedy check (Table 3). Higher wheat yield was observed with Columbus, a new brand of clodinafop, at 75, 90 & 120 g/ha [9].

Residual toxicity on succeeding crops

Mung bean and sorghum crops were planted after harvesting of wheat crop for bioassay study for residual effect of clodinafop WCPL 15WDG applied in wheat crop. Observations recorded on crop phytotoxicity during both the years of study indicated no chlorosis, necrosis, yellowing, epinasty & hyponasty after 10 days of sowing of mung bean and sorghum crops (Data not given). Also, no reduction of plant height was observed at 30 days after sowing of mung bean and sorghum crops due to application of different doses of clodinafop WCPL 15WDG and Topik applied in wheat crop during both years (Data not given). No residual toxicity was observed on succeeding sorghum crop with higher (even double) doses of clodinafop [10].

Table 3 Effect of different weed control treatments on effective tillers, 1000-grain weight, straw and grain yield of wheat

Treatment	Dose (g /ha)	No. of effective tillers/m^2		1000-grain wt. (g)		Wheat grain yield (kg/ha)		Wheat straw yield (kg/ha)	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
WCPL 15WDG	200	390	355	41.6	40.4	4567	4494	5516	5572
WCPL 15WDG	400	455	420	42.3	42.3	5374	5202	6379	6346
WCPL 15WDG	600	445	415	42.2	42.1	5406	5317	6439	6464
WCPL 15WDG	800	440	415	41.7	42.3	5381	5245	6398	6402
Clodinafop (Topik)	400	450	425	42.6	42.3	5315	5306	6324	6473
HW	15 & 30 DAS	425	395	41.4	41.1	4703	4599	5678	5696
Weedy check	-	380	350	41.3	40.6	4122	4088	4963	5028
Weed free	-	460	430	43.1	42.6	5421	5338	6462	6517
CD at 5%		6.1	7.2	NS	NS	359	281	387	302

Conclusions

The new formulation of clodinafop 15WDG at 60, 90 & 120 g/ha provided 80 to 100% control of grassy weeds (*P. minor* and *A. ludoviciana*) in wheat crop. Clodinafop 15WDG at 120g/ha caused mild injury to crop up, but it diminished within 3-4 weeks without any adverse effect on yield and no injury was observed at later stages. There was no carry over effect of different herbicides used in wheat on succeeding mung bean and sorghum crops

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