



Relative study of efficacy of weedicides to curb the impact of *phalaris minor* on hexaploid (6x) wheat yield

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Abstract

Bread wheat is one of the chief food-grains worldwide. Cut in yield is consequence of its competition with weeds for soil nutrients & water at juvenile stages and reduced quality due to adulteration at harvest. Population density of weeds, their kind and intensity of weedicides used determine the magnitude of damage. *Phalaris minor* (Dumbi sitti) is being the notorious weed of wheat crop due to its preponderance and devastating nature. Insight of delinquent behavior of aforesaid weed, an experiment was conducted following RCBD with three replications to define the best dose of clodinafop propargyl i.e. 120g/acre, 130g/acre, 140g/acre. Additionally, comparative efficacy of clodinafop propargyl, fenoxaprop-p-ethyl and sulfosulfuron at their recommended doses of 140g/acre, 500 ml/acre and 13.5 g/acre, respectively, were also tested to check *phalaris minor* (Dumbi sitti) attack during Rabi season 2016-17 and 2017-18. Maximum weed intensity (5.33 m⁻²) was pragmatic at dose 120 g/acre while least (2.00 m⁻²) was at 140 g/acre of clodinafop propargyl as compared to control (17.33 m⁻²). Lowest weed population of 1.67 m⁻² when treated with Clodinafop propargyl (140 g/acre) followed by 2.33 m⁻² and 3.67 m⁻² in fenoxaprop-p-ethyl (500ml/acre) and sulfosulfuron (13.5 g/acre), respectively were recorded along with 20.33 m⁻² value of control. For quantitative characters, maximum value of Plant height (97.67 cm), No. of tillers/plant (282.67) and 1000-grain weight (42 g) was observed for clodinafop propargyl (140 g/acre). While, least Plant height (92.33cm), No. of tillers/plant (267.33) and 1000-grain weight (36 g) was noted for sulfosulfuron (13.5 g/acre) treatment. Whereas, values of 89.33 cm, 236.67 and 31 g for plant height, No. of tillers/plant and 1000-grain weight respectively, were observed at control field condition. Hence, clodinafop propargyl was comparatively most effective weedicide having efficient dose of 140 g/acre to minimize the outbreak of *Phalaris minor* with lesser impact on grain yield and related traits.

Keywords: efficacy, clodinafop propargyl, wheat, *Phalaris minor*, sulfosulfuron

Introduction

Wheat is nutritive mainstay of one third of the entire world population. Existence as staple food marks it central to support the economy of Pakistan, hence occupies a vital place in agricultural policy assembly. Wheat renders nearly 73% of the protein and calories of the average diet (Hanif *et al.*, 2003) [30]. Wheat accounts for 9.1 % in agriculture and 1.7 % in economy of Pakistan. In Pakistan, during 2017-18 area under wheat cultivation remained 8.734 (1000-hectares) compared to 8.000 (1000-hectares) during the corresponding period of previous year. Total wheat production was 25.492 (million tonnes); 2017-18, against 26.674 (million tonnes) in last year (Pakistan Economic

Survey, 2016-17 & 2017-18). Weeds are uninvited plant species emerging in the main domesticated crop plants. In short, weeds are plants that interfere with the vigorous or usual growth and development of main crops. Even, they are known to limit the crop production by triggering striking losses in the output of seed-grains yield in wheat (Chaudhri *et al.*, 1992 & Dangwall *et al.*, 2010) [16]. Weeds are obnoxious pests that remain in the fields even after repeated management measures resulted in a loss of an agricultural productivity due to its ubiquitous nature (Riaz *et al.*, 2009) [26]. In wheat, yield losses range from 20-40% due to weeds compete for water, space, nutrients and carbon dioxide (Ahmad and Shaikh, 2003 & Oad *et al.*, 2005) [5, 21].

Table 1: Area, Production & Yield comparison of Wheat in Pakistan during last five years. (Source: Pakistan Bureau of Statistics/Pakistan Economic Survey, 2017-18)

Year	Area		Production		Yield	
	(000 Hectare)	(% change)	(000 Tonnes)	(% change)	(Kg/Hectare)	(% change)
2013-14	9,199	-	25,979	-	2824	-
2014-15	9,204	0.1	25,086	-3.5	2726	-3.5
2015-16	9,224	0.2	25,633	2.2	2779	1.9

2016-17	8,972	-2.7	26,674	4.1	2973	7.0
2017-18	8,734	-2.6	25,492	-4.4	2919	-1.8

Phalaris minor (little-seeded canary grass) locally named as Dumbi sitti, Kanki, Gullidanda, Mandusi, and Sitti is a winter annual monocot plant that grows in grows in rabi season at temperature ranges of 5-20°C. It is prevalent worldwide especially in tropical and sub-tropical regions that grow barley, oat and wheat rotated with rice. It is quite similar to wheat plants and difficult to discriminate at its early growth stages (Yasin and Iqbal, 2011) [29]. It also possesses toxic chemicals in roots and top parts which affect the development of root hairs and twist the roots of the main crop plants when applied in the form of aqueous extracts. About 300-460 seeds are produced by each plant of canary grass which results in contamination of wheat-seeds (Rammooorthy and Subbain, 2006). Weed management usually in irrigated areas by using hoeing, harrowing and cultivation practices seemed to be difficult due to again and again cultivation of same crops in same piece of land. Crop plants can utilize soil and environmental resources more efficiently if proper weed control measures are used at the time of seed sowing or immediately afterwards hence increase crop productivity (Marwat *et al.*, 2008) [19].

Keeping in view the damage caused by *Phalaris minor* in wheat two field trials were carried out with following objective:-

- First; to find out the best dose of clodinafop propargyl to control *Phalaris minor* population with minimum yield losses.
- Second; to find out the comparatively effective weedicide; clodinafop-propargyl, fenoxaprop-p-ethyl and sulfusulfuron, at their recommended doses, for the management of *Phalaris minor*.

Materials and Methods

Field trial was laid down out during fiscal years; 2016-17 and 2017-18, in district Rahimyar Khan, Pakistan. Experiment was laid out in three replicated, Randomized Complete Block Design (RCBD) with plot size of 34 m × 44 m dimension. Then, Seed bed preparation was done after Rouni-irrigation following the three cultivations with cultivator and planking operation. The promising wheat variety; Punjab-2011, was then hand-drilled at 50 Kg/acre seed rate on 15th November in both years. Recommended doses of N: P: K fertilizers (160:114:62 Kg/ha) were applied in the form of Urea, Di Ammonium Phosphate (DAP) and Sulphate of Potash (SOP), respectively. Urea was applied in three splits; first dose i.e. 1/3rd of Nitrogen with complete Phosphorous and Potassium was mixed with soil by ploughing and planking at the time of seedbed preparation. While the second and third split of urea was broadcasted at the time of 1st and 2nd irrigation, respectively. Only canal water was used for irrigation. All the standard agronomic practices were followed at optimum time and rate from sowing till harvest.

During both 2016-17 & 2017-18 years all three doses i.e. 120 g/acre, 130 g/acre, 140 g/acre of clodinafop propargyl were applied along with a Control (only water/zero dose of weedicide). Along with it three different weedicides

clodinafop-propargyl (140g/acre), fenoxaprop-p-ethyl (500 ml/acre) and sulfusulfuron (13.5 g/acre) were used separate plots to test their comparative efficacy to control *Phalaris Minor*. Data on weed (*Phalaris Minor*) population was recorded using a square-meter at four different places in each replicated treatments to get average performance of all stated weedicides. Volume of spray (300 L/ha) was determined by calibration as described by Rao, (1993). The wheat crop was sprayed with Knapsack hand sprayer having T-jet nozzle with 207 kp pressure after 45 days of sowing. Then, Quantitative trait i.e. No. of weeds (m⁻²), No. of tillers (m⁻²), plant height (cm), 1000-grain weight (g) and final grain-yield (t/ha) were recorded. Weeds density/population data was taken after 25-Days after sowing (DAS) and No. of tillers after 40 DAS. While, other stated parameters were calculated 150 DAS (at harvest). Treatment means were then analyzed by Fisher's Least Significant Difference test at p<0.05 (Steel *et al.*, 1997) [28] to compute LSD value. For data analysis statistix 8.1 statistical software was used.

Result and Discussion

Efficacy of Different Doses of Clodinafop Propargyl against *Phalaris Minor*

The data of weed population was statistically significant at different doses of clodinafop propargyl (Table 1). During first year; 2016-17, lowest weed population at 140 g/acre treatment of Clodinafop propargyl (2.07 m⁻²) and highest plant height (100.2 cm), No. of tillers (278.20), 1000-grain weight (45 g) and yield 3.970 (t/ha) was recorded. Whereas, maximum attack of *Phalaris minor* was noted for 120 g/acre dose of Clodinafop propargyl with plant height (95.3 cm), no. of tillers (252.00), 1000-grain weight (36 g) and yield (3.337 t/ha). Whereas, weed population, Plant height, no. of tillers, 1000-grain weight and yield had 16.65 m⁻², 90.20 cm, 222.63, 35 g and 2.880 t/ha values at control. Overall, clodinafop propargyl dose of 140 g/acre remained best suited in terms of its supreme efficacy. While in 2017-18 maximum weed population (5.33 m⁻²) was observed at 120 g/acre while minimum population (2.00 m⁻²) was at 140 g/acre compared to control with (17.33 m⁻²). Plant height was greater (98.33 cm) in treatment treated with clodinafop propargyl at dose 140 gm/acre whereas 95.33 and 92.67 cm height were in treatments 130 g/acre and 120 g/acre respectively compared to 87.67 cm in control. Number of tillers was more 274.33 followed by 262.67 and 249.00 in at 140 g/acre, 130 g/acre and 120 g/acre dose respectively compared to 228.67 in control. At 120 g/acre dose, 1000-grain weight was 37 g while 39g and 43g at 130 g/acre and 140 g/acre dose correspondingly, compared to control with 34 g only. Highest yield (3.910 t/ha) was of plants treated with 140 g/acre dose followed by 3.670 t/ha and 3.430 t/ha at 130 g/acre and 120 g/acre doses against control with 2.790 t/ha yield (Table 1). The data confirmed that 140 gm/acre dose was found best in managing weed population and showed significant results on different wheat growth parameters compared to other doses during both fiscal years 2016-17 & 2017-18 (Table 1).

Table 2: Efficacy of Different Doses of Clodinafop Propargyl (Weedicide) Against *Phalaris Minor* in *Triticum aestivum* l. (Bread Wheat)

Doses (Clodinafop propargyl)	Weeds (m ²)		Plant Height (cm)		No. of Tillers (No.)		1000-grain weight		Yield (t/ha)	
	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18	2016-17	2017-18
120g/acre	5.07b	5.33 b	95.3c	92.67 c	252.00c	249.00c	36c	37 c	3.337c	3.430 c
130g/acre	3.24c	3.67 c	99.1b	95.33 b	268.40b	262.67b	40b	39 b	3.580b	3.670 b
140g/acre	2.07d	2.00 d	100.2a	98.33 a	278.20a	274.33a	45a	43 a	3.970a	3.910 a
Control	16.65a	17.33 a	90.2d	87.67 d	222.63d	228.67d	35d	34 d	2.880d	2.790d
LSD value	1.12	1.37	2.21	2.33	5.4	4.3	2.47	1.99	0.018	0.023

Efficacy of Different Weedicides against *Phalaris Minor* in Bread Wheat

The data regarding quantitative parameters were statistically significant in different weedicide treatments (Table 2). In 2016-17 weed population was in decreasing order from control; 18.31 m², sulfosulfuron; 3.59 m², Fenoxaprop-p-ethyl; 2.42 m² and clodinafop propargyl; 1.61 m². was evident. Plant Height was maximum for fenoxaprop-p-ethyl (96.30 cm) followed by clodinafop propargyl (94.71 cm), control (90.62 cm) and sulfosulfuron (90.22 cm) in sequence that is contrary to previous year results. No. of tillers had increasing trend from clodinafop propargyl (285.70), fenoxaprop-p-ethyl (266.24), sulfosulfuron (261.31) to control (242.61). Parameter of 1000-grain weight was supreme for clodinafop propargyl (44 g) and tiniest for fenoxaprop-p-ethyl (36 g) against control (33 g). Furthermore, yield had highest value for Clodinafop propargyl (4.201 t/ha), and lowest for sulfosulfuron (3.795 t/ha) compared to control (2.430 t/ha). On the other hand, during 2017-18, Minimum weed population 1.67 m² was calculated for treatment; clodinafop propargyl followed by 2.33 m² and 3.67 m² in fenoxaprop-p-ethyl and

sulfosulfuron respectively compared to control with 20.33 m². Plant height was less (92.33 cm) in sulfosulfuron treatment and more (97.67 cm) at clodinafop propargyl in comparison to control with 89.33 cm. These findings correlated with the observation of Abbas *et al.* (2009)^[1] that plant height varies with the application of different weedicides. Number of tillers was 282.67, 273.67, 267.33 and 236.67 in clodinafop propargyl, fenoxaprop-p-ethyl, sulfosulfuron and control respectively.

Similarly 1000-grain weight and yield was more (42 g and 4.130 t/ha) in case of clodinafop propargyl and low (36 g and 3.830 t/ha) in sulfosulfuron respectively compared to control with 31 g and 2.570 t/ha (Table 2). The same was described by Abbas, (2007)^[2] and Bibi *et al.* (2008)^[6], who concluded that weedicides have significant effects on 1000-grains weight.

These conclusion are also in line with the previous researches on wheat carried out by shah *et al.* (1989)^[27], Khan *et al.* (2001, 2002, 2003)^[11, 8, 12, 13, 30], Hassan *et al.* (2003)^[8, 12, 13], Cheema and Akhtar (2005)^[7] and Khalil *et al.* (2008)^[10], who harvested increased grain yield of wheat with the application of different herbicides.

Table 3. Efficacy of Different Weedicides (Clodinafop Propargyl, Fenoxaprop-p-Ethyl Nad Sulfosulfuron) Against *Phalaris minor* in *Triticum aestivum* l. (Bread Wheat)

Weedicides	Weeds (m ²)		Plant Height (cm)		No. of Tillers (No.)		1000-grain weight		Yield (t/ha)	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Clodinafop propargyl	1.61d	1.67 d	94.71b	97.67a	285.70a	282.67 a	44a	42 a	4.201a	4.130a
Fenoxaprop-p-ethyl	2.42c	2.33 c	96.30a	96.33a	266.24b	273.67 b	36c	38 b	3.899b	3.940b
Sulfosulfuron	3.59b	3.67 b	90.22d	92.33b	261.31c	267.33 c	37b	36 c	3.795c	3.830c
Control	18.31a	20.33 a	90.62c	89.33 b	242.61d	236.67 d	33d	31 d	2.430d	2.570d
LSD value	4.12	4.47	2.34	3.41	2.87	3.13	3.11	3.46	0.096	0.048

Conclusion & Recommendation

Best performance of Clodinafop propargyl to control population of *Phalaris Minor* L. with less damage to core crop was documented at dose 140g/acre. All the observed characters were at finest at aforementioned dose. While, in comparison of weedicides trial Clodinafop propargyl produced better results for No. of tillers/m², 1000-grain weight (g), yield (t/ha) and second best for plant height

(cm). Hence, overall Clodinafop propargyl was superlative, comparatively. Further, it is recommended to use weedicides that produce lesser trauma with better control and minimum loss to cash crop. For this, we need to develop varieties that can bear the stress caused by weedicide application and can compete with weeds to produce handsome economic returns.

Supplementary

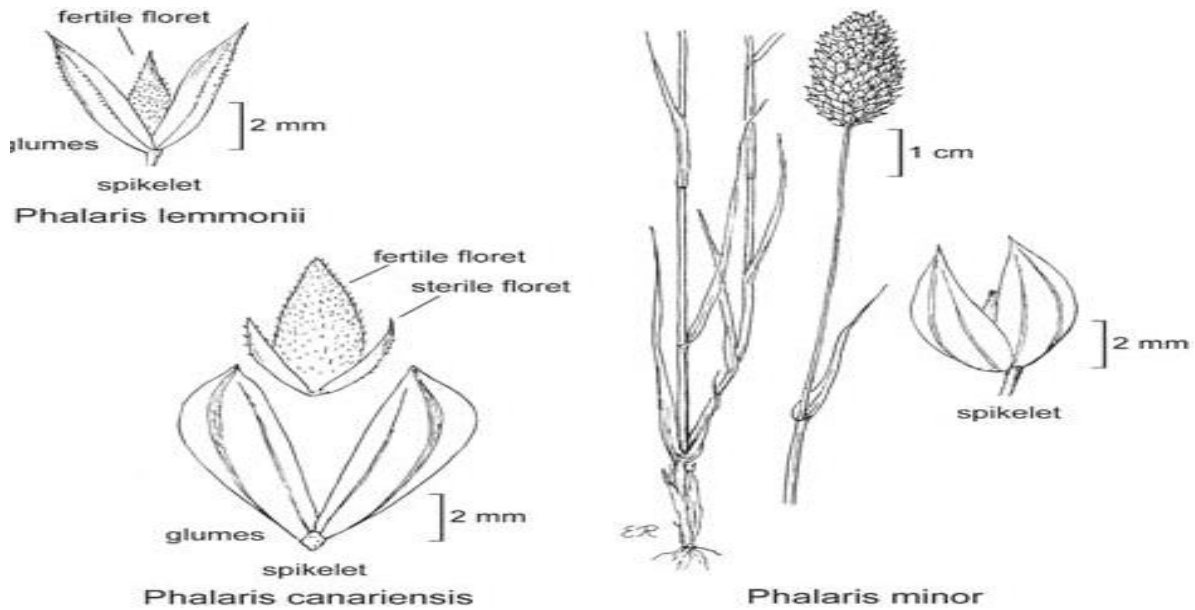


Fig 1: Phalaris Minor (Dumbi sitti/little-seeded canary grass); Botanical structure

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