Indian J. Weed Sci. **36** (3 & 4) : 166-170 (2004)

Efficacy of Clodinafop Against Isoproturon-Resistant *Phalaris minor* in Relation to Wheat Cultivars and Spacing

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ABSTRACT

Wheat cultivar PBW-343 caused maximum suppression in dry matter of *P. minor* by 30.7 and 48.5% over WH-542 and PDW-233, respectively, due to greater competition offered by more number of tillers and resulted in 6.9 and 37.5% higher grain yield over WH-542 and PDW-233, respectively. Narrower row spacing of 15 cm registered lower dry matter of *P. minor* by 18.1% due to higher number of tillers and resulted in increase in mean yield to the tune of 15.7% than normal spacing of 22.5 cm. The study further revealed that PBW-343 at closer spacing exerted more smothering effect and caused 44.5 and 34.8% reduction in dry matter of *P. minor* when compared with cultivar WH-542 at normal and closer spacing. The studies also indicated that dry matter of *P. minor* in cultivar PBW-343 when treated with clodinafop 45 g ha^{-1} was statistically same when it was compared with cultivar WH-542 and PDW-233 when these were treated with clodinafop at 60 g ha^{-1}. Wheat cultivars PBW-343 and WH-542 treated with clodinafop 45 g ha^{-1} gave significantly more grain yield than durum wheat when it was treated with clodinafop 60 g ha^{-1}. It was interesting that use of cultivar PBW-343 in association with clodinafop 45 g ha^{-1} and closer spacing of 15 cm gave significantly more grain yield when it was sown at normal spacing of 22.5 cm alongwith higher dose of clodinafop 60 g ha^{-1}. Further, the study revealed that bread wheat cultivars PBW-343 and WH-542 at closer spacing when treated with clodinafop either at 45 g ha^{-1} or 60 g ha^{-1} gave statistically same yield, however, in case of durum wheat PDW-233, the grain yield significantly decreased at closer spacing when treated with clodinafop at 45 g ha^{-1} in comparison to 60 g ha^{-1}.

INTRODUCTION

Productivity of irrigated wheat is greatly influenced by several weeds, the most important among these is the *Phalaris minor*. Adoption of a rice-wheat rotation coupled with irrigation and fertilizer use produced ecological conditions favouring *P. minor* growth and development, which became a serious problem in the wheat crop. Cultivars play an important role in crop-weed competition because of morphological feature (Verschwele and Niemann, 1996), canopy structure (Gagoi *et al.*,1993) and relative growth rate (Balyan *et al.*, 1991). Early canopy cover can provide better shading and smothering of weeds to ensure optimal utilization of growth resources in its favour (Brar, 1994). Information about the competitive behaviour of recently developed double dwarf cultivars of wheat against *P. minor* needs to be generated. In a crop-weed ecosystem, increasing the crop plants per unit area/narrower row spacing greatly facilitate weed suppression by maintaining dominant position over weeds as the less space is left for the growth of weeds (Singh *et al.*,1995) and also through modification in canopy structure (Teasdale and Frank, 1983; Gill,1992). Recently, clodinafop has been found quite effective against *P. minor*. But, there is every risk of development of cross-resistance of these herbicides against *P. minor*. The present investigation carried out with the objective to find out interaction, if any, between wheat cultivars, row spacing and clodinafop doses on *P. minor* in wheat in order to know if the doses of clodinafop can be reduced due to added effect of varieties and closer spacing.

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MATERIALS AND METHODS

A field study was conducted during winter seasons of 2000-01 and 2001-02 at the Research Farm of Punjab Agricultural University Regional Station, Gurdaspur (India) situated at an altitude of 250 m above mean sea level, 32°20′ N latitude and 75°22′ E longitude. The experiment was laid out in split plot design with three replications having cultivars (PBW 343, WH 542 bread wheat's and PDW 233 durum wheat) and row spacing (15.0 and 22.5 cm) as main plot and weed control treatments (clodinafop at 30, 45 and 60 g ha^{-1}) as sub-plots (Table 1). The soil was sandy loam having 62.0% sand, 21.2% silt and 15.8% clay (in top 15 cm), medium in organic carbon (0.40%) and potassium, low in available nitrogen and higher in phosphorus. Soil reaction and electrical conductivity were normal. The crop was sown at recommended seed rate on November 10 during both the seasons. The recommended package of practices was adopted to raise the crop. Clodinafop was sprayed with a knapsack sprayer fitted with a flat fan nozzle delivering 500 l ha^{-1} volume rate at a pressure of 420 Kpa.

Table 1. Effect of different treatments on the dry matter of *P. minor* and wheat (Mean of two seasons)

Treatment	Dry weight of *P. minor* (g m^{-2})	Wheat spikes (No. m^{-2})	Wheat yield (t ha^{-1})
Cultivars			
PBW-343	64.0	364	3.70
WH-542	93.0	314	3.46
PDW-233	125.0	283	2.69
LSD (P=0.05)	7.0	5.6	0.10
Row spacing (cm)			
15	85.0	334	3.51
22.5	104.0	307	3.03
LSD (P=0.05)	6.0	5.6	0.09
Weed control treatments			
Weedy	198.0	195	2.08
Clodinafop 30 g ha^{-1}	107.0	328	3.10
Clodinafop 45 g ha^{-1}	52.0	368	3.78
Clodinafop 60 g ha^{-1}	20.0	390	4.12
LSD (P=0.05)	7.0	5.8	0.12

RESULTS AND DISCUSSION

At crop harvest, dry matter acumulation by *P. minor* growing among cultivars PBW-343 and WH-542 was of the order of 48.5 and 25.7% less than that obtained in the durum wheat cultivar PDW-233 (Table 1). An edge in the competitive cvs. PBW-343 and WH-542 over PDW-233 was reflected in terms of mature tillers, which increased to the tune of 28.6 and 10.9% and exerted more canopy pressure over PDW-233. It was interesting that PBW-343 caused maximum suppression in dry matter of *P. minor* by 30.7 and 48.5% over WH-542 and PDW-233, respectively, due to greater competition offered by more wheat spikes and resulted in 6.9 and 37.5% higher grain yield over WH-542 and PDW-233, respectively.

Narrow row spacing (15 cm) significantly increased grain yield by 15.8% over the row spacing of 22.5 cm. The increase in grain yield due to narrow row spacing may be attributed to a significant reduction in dry matter of *P. minor* compared to normal spacing of 22.5 cm (Table 1). PBW-343 at closer spacing exerted more smothering effect and

caused 44.5 and 34.8% reduction in dry matter of this weed when compared with WH-542 at normal and closer spacing, respectively (Fig.1).

With each increment in the dose of clodinafop wheat spikes and grain yield increased significantly over the previous dose (Table 1). The dry matter of

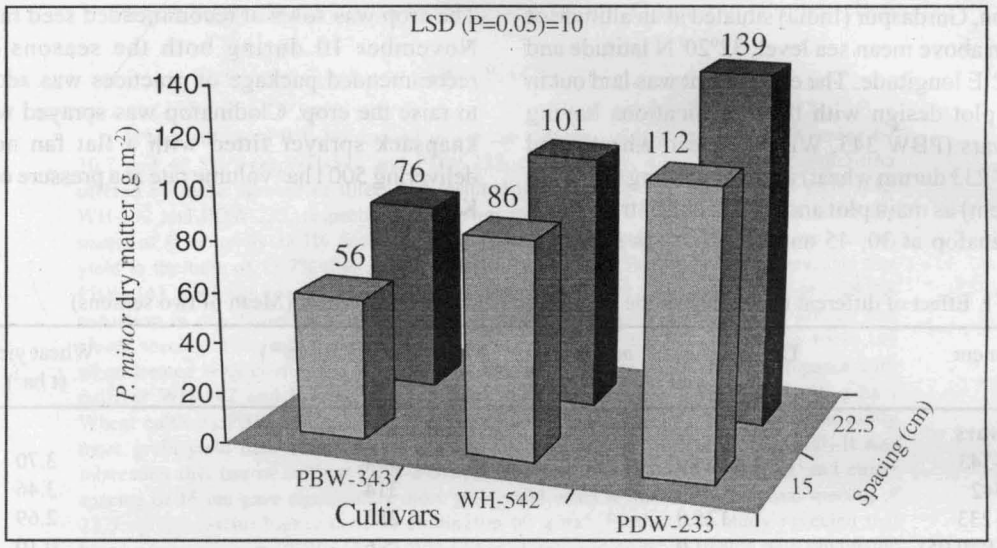

Fig. 1. Interactive effect of cultivars x spacing on the dry matter of *P. minor* (g m^{-2}) (Mean of two seasons).

P. minor in cultivar PBW-343 treated with clodinafop at 45 g ha^{-1} was statistically same when it was compared with WH-542 and PDW-233 treated with clodinafop at 60 g ha^{-1} (Fig. 2). PBW 343 and WH-542 treated with clodinafop at 45 g ha^{-1} gave significantly more grain yield than durum wheat

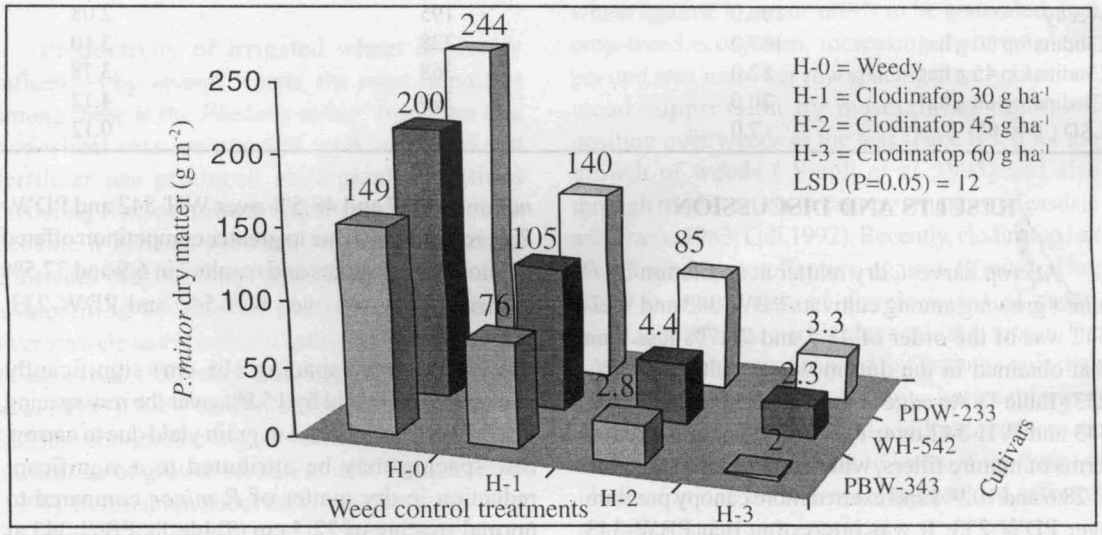

Fig. 2. Interactive effect of cultivars x weed control treatments on the dry matter of *P. minor* (g m^{-2}) (Mean of two seasons).

when it was treated with clodinafop at 60 g ha^{-1}. It was interesting that PBW-343 at closer spacing and treated with clodinafop at 45 g ha^{-1} gave significantly more grain yield when it was sown at normal spacing (22.5 cm) and treated with higher dose of clodinafop at 60 g ha^{-1} (Table 2). The similar trend was noticed in case of wheat spikes (Table 3). Further interaction effect of culivar x spacing and weed control treatments on grain yield of wheat (Table 2) revealed that bread wheat cultivars PBW-343 and WH-542 at closer spacing when treated with clodinafop either at 45 g ha^{-1} or 60 g ha^{-1} gave statistically same yield, however, in case of durum wheat PDW-233, the grain yield significantly decreased at closer spacing when treated with clodinafop at 45 g ha^{-1} in comparison to 60 g ha^{-1}. Hence, it was concluded from the study that we could curtail the dose of clodinafop from 60 g ha^{-1} to 45 g ha^{-1} for the control of *P. minor* by selecting suitable cultivars PBW-343 and WH-542, which have great smothering effect and early canopy cover when these were planted at closer spacing.

Table 2. Interactive effect of cultivars x spacing x weed control treatments on wheat yield (t ha^{-1}) (Mean of two seasons)

Treatment	Weedy		Clodinafop 30 g ha^{-1}		Clodinafop 45 g ha^{-1}		Clodinafop 60 g ha^{-1}	
	15 cm	22.5 cm	15 cm	22.5 cm	15 cm	22.5 cm	15 cm	22.5 cm
PBW-343	2.65	2.21	4.12	3.41	4.55	3.74	4.71	4.23
WH-542	2.54	1.59	3.04	3.14	4.47	3.69	4.58	4.28
PDW-233	1.82	1.70	2.70	2.17	3.32	2.92	3.66	3.27
LSD (P=0.05)	0.29							

Table 3. Interactive effect of cultivars x spacing x weed control treatments on wheat spikes (No. m^{-2}) of wheat (Mean of two seasons)

Treatment	Weedy		Clodinafop 30 g ha^{-1}		Clodinafop 45 g ha^{-1}		Clodinafop 60 g ha^{-1}	
	15 cm	22.5 cm	15 cm	22.5 cm	15 cm	22.5 cm	15 cm	22.5 cm
PBW-343	241	212	363	331	461	402	472	424
WH-542	199	176	342	315	361	352	393	372
PDW-233	175	164	317	297	326	303	349	327
LSD (P= 0.05)	14							

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