Indian J. Weed Sci. **39** (1 & 2) : 66-73 (2007)

Impact Analysis of Factors Affecting *Phalaris minor* Infestation in Wheat in Punjab

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ABSTRACT

Phalaris minor has become the major menace in wheat, as it has developed resistance against isoproturon. The farmers are using costly herbicides, namely, clodinafop and sulfosulfuron. A critical analysis of the data revealed that recommended seed rate, bi-directional and zero till method of sowing are some of the factors whose added returns were higher than added costs from wheat because of low infestation of weeds and increase in wheat productivity. Other factors which led to low infestation of *Phalaris minor* included light soil, low moisture content at upper layer of soil, early sowing of wheat, closer spacing, use of new herbicides, recommended dose of herbicide, use of flood zet & flat fan nozzles, adequate volume of spray, adoption of PBW 343 variety of wheat, crop rotation (potato, sugarcane, vegetables and berseem crop in previous year), one hoeing after first irrigation and application of gypsum. Wheat growers can be benefited a lot if integrated approach of weed management is followed.

INTRODUCTION

Weeds compete with crops for sunshine, space and plant nutrients and cause lot of damage to crops. *Phalaris minor* not only competes with growth factors but also forces the crop to lodge, and the losses in wheat grain yields to the tune of 50% are quite obvious (Walia *et al.*, 2001). There are different methods to control weeds but use of herbicide(s) is the most popular method. Before 1970, weeds in wheat used to be controlled by manual labour but infestation of *P. minor* in wheat crop necessitated the use of herbicide(s). Initially, this herbicide provided very effective control of *P. minor* but overtime due to the sole use of this herbicide in wheat, *P. minor* developed resistance against isoproturon. Continuous use of isoproturon, with its over/ under doses and faulty method of spray including broadcast application, made this herbicide ineffective against *P. minor*. Now most of the *P. minor* biotypes are not controlled by isoproturon even at double the recommended dose (1.88 kg/ha) rather it showed phyto toxic effects on the wheat crop (Walia *et al.*, 1997). To overcome this problem, new herbicides were recommended which proved effective against *P. minor*. But still there is an apprehension that *P. minor* may develop resistance to new herbicides too. Thus, great emphasis on the adoption of other practices, which minimize *P. minor* infestation, has assumed great importance. Keeping this in view, it was planned to study factors affecting *P. minor* infestation in wheat, which is based on the perception of farmers and analytical reasoning of the scientists.

MATERIALS AND METHODS

The present study was conducted in 2004, in Amritsar, Gurdaspur, Kapurthala, Ferozepur, Bathinda, Faridkot and Sangrur districts of the Punjab state, under the research project, 'Herbicides-resistant Weeds of Wheat in India and Australia : Integrated Management', funded by Australian Centre for International Agricultural Research, Australia. About 15 wheat growers were selected from each district constituting a sample of 104 wheat growers. To collect the data from the respondents, a comprehensive interview schedule was structured. The schedule was pre-tested and modified accordingly. The information about the factors affecting infestation of *P. minor* was collected alongwith its impact on the cost involved and productivity of wheat. Farmer's response, about the factors affecting infestation of *P. minor,* was measured at three points continuum scale viz., High (H), Medium (M) and Low (L).

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RESULTS AND DISCUSSION

The data on the impact of the factors such as soil type and moisture content, seed rate and source of seed on the infestation of *P. minor* have been given in Table 1.

Soil Type and its Moisture Content

As high as 86.21% wheat growers reported high weed infestation in heavy soils with higher water retention capacity. As many as 71.43% farmers reported medium infestation of weeds in medium type of soil. In light soils, isoproturon adequately controlled weeds as 69.24% farmers reported low weed infestation. As many as 81.84% farmers reported high weed infestation in case of soils having high moisture content.

Source of Seed and Seed Rate

High weed infestation was reported by 66.30 and 100% farmers who used their own seed and obtained the seed from fellow farmers, respectively. Three-fourth of the farmers who used certified seeds reported low weed infestation. When farmers used seed from PAU, added return of Rs. 630 was higher than added cost of Rs. 210, and the cost benefit : ratio worked out was at 1 : 3 (Table 1).

Low weed infestation was reported by 24.19 and 62.50% farmers using recommended and more than recommended seed rate, respectively. Whereas among the farmers, who used less than recommended seed rate, 48.27 and 44.83%, reported high and medium weed infestation, respectively. From the above results, it is quite evident that in no case, less than recommended seed rate be used. Higher plant population, due to increased seed rate, provided higher suppressing effect on *P. minor*.

Table 2 envisages the impact of sowing time, method of sowing and application of farmyard manure (FYM) and gypsum on the infestation of *P. minor*.

Sowing Time

As many as 50% of the farmers reported low weed infestation when sowing of wheat was done in the last week of October. This could be because of high temperature in the end October as *P. minor* has been reported to germinate at 17-18°C temperature which usually prevails in the mid of November.

Method of Sowing

The data revealed that 41.30% farmers reported low weed infestation when sowing was done at closer spacing of 17.5 cm. This was due to the fact that closer spacing of wheat provided more suppressing effect on weeds, as the less space was available to weeds. Closer row spacing of 15 cm has already been reported to result in less population and dry matter of *P. minor* as compared to normal spacing of 22.5 cm because of wheat tiller canopy coverage over the weeds (Chahal *et al.*, 2003). Even in broadcasting method, farmers who used more than recommended seed rate reported more suppressing effect by the crop. Also 75.00% farmers reported low weed infestation in case of bi-directional sowing because of higher suppressing effect due to better tiller canopy structure. Adoption of zero tillage proved very effective in eliminating *P. minor* as 92.31% farmers reported low weed infestation by sowing with zero till drill and none reported high weed infestation in wheat sown with this technique. This could be due to no disturbance of *P. minor* seeds lying in the deeper layers of soil, as it germinates from the upper layer (<3 cm deep) only.

Impact of Farmyard Manure (FYM) and Gypsum

Majority of the farmers (92.16%) reported higher weed infestation where FYM (not well rotten) was applied. Non application of well rotten FYM in majority of the cases could contain large number of weed seeds. However, only 1.96% farmers reported low weed infestation where well rotten FYM was applied. Those who applied gypsum, all of them reported low weed infestation (Table 2).

The data on the impact of different herbicides' dose and number of sprays on the *P. minor* have been given in Table 3.

Herbicide Used

Efficacy of fenoxaprop-p-ethyl, clodinafop and sulfosulfuron was higher than other herbicides. Out of these herbicides, clodinafop was being used widely as compared to other herbicides because with this added returns were higher than added costs.

Major cause of using un-recommended herbicides was higher cost of newly recommended

Table 1. Impact of soil type, moisture content, seed rate and source of seed on infestation of *Phalaris minor*

Particulars	No. of farmers														
	Soil type			Moisture content			Seed rate			Source of seed					
	Light	Medium	Heavy	High	Medium	Low	<Rec.	Rec.	>Rec.	PAU	PUN-Seed	Fellow farmer	Certified seed from shops	Agri. Dept.	Own
(i) Weed infestation															
High	2 (15.38)	7 (20)	50 (86.21)	27 (81.84)	24 (26.67)	2 (16.67)	14 (48.27)	19 (30.65)	4 (25)	1 (33.33)	1 (20)	4 (100.00)	-	-	61 (66.30)
Medium	2 (15.38)	25 (71.43)	8 (13.79)	6 (18.18)	55 (61.11)	2 (16.67)	13 (44.83)	27 (43.55)	2 (12.50)	2 (66.67)	2 (40)	-	1 (25)	2 (100)	30 (32.61)
Low	9 (69.24)	8 (13.79)	-	-	11 (12.22)	8 (66.66)	2 (6.90)	15 (24.19)	10 (62.50)	-	2 (40)	-	3 (75)	-	1 (1.09)
Not at all	-	-	-	-	-	-	-	1 (1.61)	-	-	-	-	-	-	-
(ii) Cost involved and effect on yield															
Cost involved (Rs./ acre)	-	-	-	-	-	-	-62.67	-	+44.17	+210	+210	-	+210	-	-
Increase/decrease in yield (kg/acre/value)	-	-	-	-	-	-	Low	-	High	+100 kg/ Rs. 630	-	-	-	-	-

Figures in parentheses are percentages to the total in the respective category.
No. of farmers reporting a particular phenomenon may increase the sample size because of multiple responses.

Table 2. Impact of sowing time, method of sowing, FYM and gypsum application on infestation of *Phalaris minor*, cost and productivity of wheat

Particulars	No. of farmers													
	Sowing time					Spacing/Method of sowing				Application of FYM and gypsum				
	End-Oct.	1-7 Nov.	8-14 Nov.	15-30 Nov.	Dec.	Drill (cm)		Broadcast	Bi-directional	Zero tillage	FYM		Gypsum	
						17.5	22.5				Applied	Not applied	Applied	Not applied
(i) Weed infesation														
High	3 (21.43)	18 (30.5)	12 (30.77)	4 (44.44)	1 (11.11)	12 (26.09)	15 (62.50)	3 (10)	1 (25)	-	47 (92.16)	-	-	-
Medium	4 (28.57)	25 (42.37)	18 (46.15)	4 (44.45)	5 (55.55)	15 (32.61)	8 (33.33)	15 (50)	-	1 (7.69)	3 (5.88)	-	-	-
Low	7 (50)	16 (27.12)	9 (23.08)	1 (11.11)	3 (33.34)	19 (41.30)	1 (4.17)	12 (40)	3 (75)	12 (92.31)	1 (1.96)	-	2 (100)	-
Not at all	-	-	-	-	-	-	-	-	-	-	-	-	-	-
(ii) Cost involved and effect on yield														
Cost (Rs.)	-	-	-	-	-	+91.25	+65	-126.74	+130	-509.72	+819.38	-	1250	-
Increase/decrease in yield (kg/acre/value)	-	-	-	-	-	-	-	-	+82/ Rs. 516.6	+100/ Rs. 630	+149.28/ Rs. 940.5	-	-	-

Figures in parentheses are percentages to the total in the respective category.
No. of farmers reporting a particular phenomenon may increase the sample size because of multiple responses.

Table 3. Impact of different brands of herbicide, herbicidal dose and number of sprays on *Phalaris minor* infestation

Weed infestation	No. of farmers											
	Puma Super	Leader	Topik	Mcata	Isoproturon	Fateh	<Rec.	Rec.	>Rec.	Un-recommended	No. of sprays	
											1	2
High	1 (17.14)	1 (6.25)	5 (9.61)	2 (25)	3 (21.43)	-	7 (24.14)	4 (8.69)	4 (8.69)	-	16 (16.32)	-
Medium	1 (7.14)	-	3 (5.77)	6 (75)	7 (50)	-	14 (14.28)	10 (21.74)	6 (30)	11 (100)	20 (20.41)	-
Low	8 (57.14)	13 (81.25)	40 (76.92)	-	4 (28.57)	-	4 (13.79)	30 (65.22)	10 (50)	-	54 (55.10)	5 (100.00)
Not at all	4 (28.58)	2 (12.50)	4 (7.70)	-	-	1 (100)	-	2 (4.35)	-	-	8 (8.16)	-
Cost involved (Rs./acre)	661.39	604	657	291.94	252.5	650	-	-	-	-	-	-

Figures in parentheses are percentages to the total in the respective category.
No. of farmers reporting a particular phenomenon may increase the sample size because of multiple responses.
Rec. stands for Recommended.

herbicides. Some of the farmers were found using even under dose of new herbicides due to high cost of these herbicides. It was observed that 24.14 and 14.28% of the farmers who used under dose reported high and medium extent of weed infestation, respectively. As many as 65.22% farmers reported low weed infestation when they used recommended dose of herbicides. In problematic areas, use of higher dose of isoproturon than recommended reported good performance. Though only one spray of herbicides is recommended, however, some farmers due to inadequate control of *P. minor* with isoproturon repeated spraying with new herbicides which enhanced the cost of weed control.

New herbicides were reported to control weeds satisfactorily even when these were sprayed 40-60 days after sowing of wheat and 10-15 days after the application of isoproturon (Table 3).

Impact of the Nozzle and Spray Volume

The use of nozzle matters for obtaining desired efficacy of herbicides. As many as 29.6% farmers reported no weed infestation when they used flood jet nozzle and 48.96% farmers reported low weed infestation when they used flood fan nozzle indicating that these are the most appropriate nozzles for spraying weedicides. This is the reason that flood jet and flat fan types of nozzles are the most used nozzles for high volume spray. It was further investigated that 61.3% farmers reported low weed infestation when they used recommended volume of water. Use of low volume of spray gave poor results (Table 4).

Table 4. Impact of type of nozzle and volume of water used for herbicide spray on *Phalaris minor* infestation

Weed infestation	Nozzle type					Water used		
	Flood jet	Flat fan	Multiboom	Cut	Power spray	<Rec.	Rec.	>Rec.
High	2 (1.40)	8 (16.33)	-	-	-	14 (42.42)	3 (4)	-
Medium	5 (18.52)	16 (32.65)	14 (56)	-	-	14 (42.42)	17 (22.67)	-
Low	12 (44.45)	24 (48.96)	11 (44)	1 (100)	1 (100)	5 (15.16)	46 (61.33)	1 (100)
Not at all	8 (29.63)	1 (2.04)	-	-	-	-	9 (12)	-

Figures in parentheses are percentages to the total in the respective category.
No. of farmers reporting a particular phenomenon may increase the sample size because of multiple responses.
Rec. stands for Recommended.

Varietal Adoption

The data in Table 5 envisage that fast growing varieties with maximum tillering capacity provide maximum suppressing effect on weeds. PBW 343 having such characteristics provided maximum suppressing effect on weeds as 32.63% farmers reported low and 45.26% reported medium weed infestation, while 1.05% of farmers reported no infestation of *P. minor* when they grew PBW 343. It is being grown in more than 90% of the total area under wheat in Punjab as it is high yielding, variety. Moreover, the variety being long duration also, most of the farmers sow this variety in last week of October or first week of November. Upto this time *P. minor* does not germinate due to early establishment of crop by mid-November and the delayed emerged plants of *P. minor* are suppressed by the wheat crop.

Crop Rotation

All the farmers reported low weed infestation when wheat followed potato in sequence. More than 90% of the farmers applied no herbicide in wheat crop, which followed potato crop. Even 93.75% farmers reported low weed infestation when wheat followed cotton. Low weed infestation was also reported by all the farmers who had sown berseem in previous **rabi** season (Table 5).

From the whole investigation, the inference can be drawn that wheat growers can be benefited a lot if integrated approach of weed management is followed.

Table 5. Impact of varieties and crop/crop sequence on infestation of *Phalaris minor*

Weed infestation	Varieties adopted							Previous crop							
	PBW 343	PBW 502	HD 2329	PBW 273	HD 2687	PBW 138	PBW 373	Paddy	Potato	Basmati rice	Sugarcane	Fodder	Vegetables	Cotton	Berseem (in **rabi**)
High	20 (21.06)	-	5 (33.33)	-	1 (100)	-	1 (25)	67 (64.42)	-	1 (33.33)	-	1 (50)	-	-	-
Medium	43 (45.26)	1 (100)	10 (66.67)	2 (100)	-	-	1 (25)	31 (29.81)	-	2 (66.67)	-	-	1 (50)	1 (6.25)	-
Low	31 (32.63)	-	-	-	-	1 (100)	2 (50)	6 (5.77)	1 (100)	-	2 (100)	1 (50)	1 (50)	15 (93.75)	2 (100)
Not at all	1 (1.05)	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figures in parentheses are percentages to the total in the respective category.
No. of farmers reporting a particular phenomenon may increase the sample size because of multiple responses.

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