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Role of Variable Tillage Depths on the Seed Bank Dynamics of *Phalaris minor* Retz. in Wheat

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ABSTRACT

Dry matter of *Phalaris minor* recorded at the time of harvest was found to be lower in the wheat crop sown after giving deep/inverted tillage with mould board plough during the start of the experiment and consequently the number of seeds of *P. minor* in the top 0-15 cm soil depth was found to be significantly less in these treatments as compared to the plots of continuous zero till sown crop for three years. Post-emergence application of clodinafop 60 g ha^{-1}, sulfosulfuron 25 g ha^{-1} and fenoxaprop-p-ethyl 100 g ha^{-1} was found to be at par with respect to dry matter accumulation by *P. minor*. However, seed bank recorded during the year of termination was found to be significantly less in clodinafop, sulfosulfuron as compared to fenoxaprop-p-ethyl treated plots. Wheat sown after giving inverted tillage (during 2001-02) produced significantly higher grain yield as compared to the crop sown with zero tillage or zero tillage followed by normal tillage.

INTRODUCTION

The continuous adoption of rice-wheat system in wheat growing regions of India has led to the serious problem of *Phalaris minor* causing yield reduction of 30-80% (Malik *et al.*, 1996) and its control to obtain economical yields is essential. Tillage is an important component of weed management. There are two schools of thoughts regarding intensity of *P. minor* in zero till sown crop. Some workers reported higher weed infestations (Mahajan, 1999), whereas others reported lower infestation (Mehla *et al.*, 2000) in zero till sown wheat crop. So, investigations were initiated to find out the role of tillage techniques on the growth, development of *P. minor* and its seed bank in wheat under rice-wheat sequence.

MATERIALS AND METHODS

Investigations were carried out at the research farm of the Department of Agronomy and Agrometeorology from 2001-02 to 2003-04 in Basmati rice-wheat rotation on loamy sand soil with 83.0% sand, 13.7% silt and 3.3% clay. The experimental field was low in organic carbon, medium in phosphorus and high in available potassium. A general crop of Basmati rice was transplanted directly after flooding with water without puddling during **kharif** 2002 and 2003. Experimental plots were sprayed with glyphosate twice at an interval of 10 days before transplanting rice seedlings. At the start of the experiment, four main plots were kept and in two blocks ploughing with mould board plough was done and remaining two plots remained untilled. During the succeeding years i. e. 2002-03 and 2003-04 each inverted tillage as well as zero tillage plots were followed by zero and normal tillage treatments, respectively. Four herbicide treatments (clodinafop 60 g ha^{-1}, sulfosulfuron 25 g ha^{-1}, fenoxaprop-p-ethyl 100 g ha^{-1} and weedy) were kept in sub-plots. The herbicidal treatments were sprayed 30-35 days after sowing with knapsack sprayer fitted with flat fan nozzle with spray volume of 250 l ha^{-1}.

PBW 343 variety of wheat was sown during second fortnight of November with zero till drill and seed-cum-fertilizer drill in the zero and normal till plots, respectively, by using constant seed rate of 100 kg ha^{-1}. The wheat crop was raised by applying 125 kg N, 62.5 kg P_2O_5 and 30 kg K_2O ha^{-1}. Whole of phosphorus and potassium and half of nitrogen was applied at the time of sowing and remaining half nitrogen was given at the time of first irrigation. Dry

Table 1. Dry matter accumulation by *P. minor* influenced by tillage and weed control treatments in wheat

Tillage system			Dry matter of *P. minor* (kg ha^{-1})				Seeds of *P. minor* kg^{-1}
2001-02	2002-03	2003-04	2001-02	2002-03	2003-04	Mean	of dry soil (2003-04)
Inverted	Zero	Zero	670	1170	215	685	30.5
Inverted	Normal	Normal	600	1290	237	709	31.7
Zero	Zero	Zero	760	1770	265	932	45.8
Zero	Normal	Normal	770	1020	217	669	29.1
LSD (P=0.05)			NS	280	NS	NS	4.5
Weed control treatments							
Clodinafop 60 g ha^{-1}			100	210	114	141	10.7
Sulfosulfuron 25 g ha^{-1}			60	290	113	154	12.1
Fenoxaprop-p-ethyl 100 g ha^{-1}			100	1060	176	445	30.4
Weedy			2540	3690	1531	2587	83.9
LSD (P=0.05)			254	320	60	540	5.7

NS=Not Significant.

matter of *P. minor* was recorded at the time of harvest with the use of quadrate measuring 50 cm x 50 cm. Soil samples to study seed bank of *P. minor* were taken with the tube auger from top 0-15 cm soil layer of all experimental plots before sowing wheat during 2003-04. Number of seeds of *P. minor* showing germination from 100 g of dry soil of representative soil samples obtained by mixing soil of four samples per experimental unit were recorded after putting soil in plastic tray which was kept at room temperature in the lab. during the month of December.

RESULTS AND DISCUSSION

The crop sown with zero tillage for continuous three years accumulated more dry matter of *P. minor* but the differences among different tillage system were non-significant during 2001-02 and 2003-04 (Table 1). However, during 2002-03, the crop sown with zero tillage showed significantly higher dry matter accumulation by *P. minor* as compared to other tillage treatments. Among weed control treatments, dry matter accumulation by *P. minor* in the crop treated with clodinafop 60 g ha^{-1}, sulfosulfuron 25 g ha^{-1} and fenoxaprop-p-ethyl 100 g ha^{-1} was found to be statistically at par among themselves (except 2002-03) but was found to be significantly superior to weedy treatment. The performance of fenoxaprop-p-ethyl 100 g ha^{-1} was found to be significantly inferior during 2002-03 as compared to clodinafop 60 g ha^{-1} and sulfosulfuron 25 g ha^{-1} as the former herbicide is comparatively weak herbicide than the latter ones. Soil seed bank (*P. minor*) studies conducted before sowing the wheat crop during 2003-04 crop season indicated that wheat crop sown with continuous zero tillage recorded significantly higher seed bank values of *P. minor* as compared to other planting techniques (Table 1). Hoffman *et al.* (1998) also reported more number of weed seeds in the top 5 cm of soil in no-tillage plots as compared to conventional tillage plots where mould board ploughing inverted the soil. Also crop treated with clodinafop 60 g ha^{-1} and sulfosulfuron 25 g ha^{-1} recorded significantly less seed bank as compared to fenoxaprop-p-ethyl 100 g ha^{-1} treated crop due to higher efficacy of the former herbicides. However, all the three herbicide treatments recorded significantly less seeds of *P. minor* in soil as compared to weedy treatment.

Tillage treatments did not cause variation in number of wheat spikes. Number of spikes was significantly higher in herbicide treated plots than weedy. Different herbicide treatments had almost similar number of spikes, except in 2002-03 where number of wheat spikes was less in fenoxaprop-p-ethyl as compared to other herbicides.

Highest grain yields of wheat were recorded in the plots which were given inverted tillage during 2001-02 and were followed by zero and normal tillage, respectively, for the successive two years and both

Table 2. Total spikes and grain yield of wheat as influenced by different tillage and weed control treatments

Tillage systems			No. of spikes m^{-2}				Grain yield (kg ha^{-1})			
2001-02	2002-03	2003-04	2001-02	2002-03	2003-04	Mean	2001-02	2002-03	2003-04	Mean
Inverted	Zero	Zero	278	230	270	259	3009	3316	3470	3265
Inverted	Normal	Normal	275	229	269	258	3144	3061	3450	3218
Zero	Zero	Zero	246	212	260	239	2655	2590	3240	2828
Zero	Normal	Normal	258	237	265	253	2409	3197	3370	2992
LSD (P=0.05)			NS	NS	NS	NS	248	326	NS	245
Weed control treatments										
Clodinafop 60 g ha^{-1}			318	274	273	289	3310	3630	3650	3530
Sulfosulfuron 25 g ha^{-1}			309	281	279	290	3396	3578	3650	3541
Fenoxaprop-p-ethyl 100 g ha^{-1}			302	210	284	266	3200	3017	3290	3169
Weedy			127	142	228	166	1311	1939	2940	2063
LSD (P=0.05)			30	32	16	42	475	284	212	406

NS–Not Significant.

these treatments significantly increased grain yield of wheat as compared to continuous zero till treatment because in zero tillage plots germination of wheat was slightly less than tilled plots. The treatments of continuous zero tillage and zero tillage followed by normal tillage were found to be at par with respect to grain yield. It is also interesting to note that the crop sown with zero tillage continuously produced significantly less grain yield than the zero tillage techniques followed after giving deep tillage for one year which indicates that with inverted tillage majority of seeds of *P. minor* were buried in the deep soil layer which were unable to germinate and consequently there was less infestation of *P. minor* in this treatment (Table 2). Inverted tillage followed by zero till wheat increased grain yield by 15.4 and 9.1% as compared to continuous zero till as well as zero till followed by normal till sown wheat crop, respectively. Hosmani and Meti (1993) also found that inversion tillage such as mould board ploughing resulted in burial of large proportion of weed seed in deeper layer compared to non-inversion (chisel).

Among the herbicide treatments, clodinafop and sulfosulfuron produced nearly the same grain yield and significantly higher than fenoxaprop-p-ethyl during 2002-03 and 2003-04, which may be due to slightly poor control of *P. minor* with this herbicide. However, during 2001-02 and in pooled data all three tried herbicides produced grain yield at par among themselves. Post-emergence application of clodinafop 60 g ha^{-1} and sulfosulfuron 25 g ha^{-1} provided excellent control of *P. minor* and these treatments resulted in 10.3 and 87.2% increase in grain yield (average of three years) as compared to fenoxaprop-p-ethyl and weedy, respectively (Table 2). Overall, low wheat grain yields than the state average yields were recorded during all the years of study which may be due to late sowing of wheat after the harvest of Basmati rice (in the 3rd or 4th week of November).

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