Dynamics of *Phalaris* minor in wheat (*Triticum aestivum L.*) under different establishment methods and weed control measures

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***Abstract*—** *A field experiment was conducted during rabi season of 2013-2014 at crop research centre Pantnagar (Uttarakhand) to examine the behaviour and magnitude of Phalaris minor and its dynamics in different combinations of establishment methods and weed control measures in wheat (Triticum aestivum L.). Density of Phalaris minor was highest under RTW as compared to CTW and ZTW at 60, 90 DAS and also at maturity stage. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha and clodinafop-propargyl @ 60 g/ha completely controlled Phalaris minor. Dry matter accumulation by Phalaris minor was highest under RTW which was at par with CTW but significantly higher over ZTW at 30, 90 DAS and at maturity.*

***Keywords*— zero tillage, conventional tillage, roto till seed drill, wheat, Phalaris minor**

I. INTRODUCTION

Wheat is the second most important food grain next to rice in India in terms of area and production with a targeted annual growth rate of 1.9 with respect to yield (DAC, 2013-14). Weeds account for about one third of total losses caused by various biotic stresses (Gopinath and Mina, 2009). Yield reduction to the tune of 15 to 50 % or sometime more depending upon the weed density and weed flora also reported (Jat et al., 2003). Wheat fields in Northern India are hugely infested with wide range of grassy and non grassy weeds in general and Phalaris minor Retz. in particular. To tackle with the problems of weed infestation, different tillage practices tested in different climatic situations. But, change in tillage leads to change in weed flora. Use of herbicides can be effectively integrated with different planting patterns like zero tillage, strip till drill, roto till seed drill etc. sowing in standing stubbles, and zero till sowing with complete or partial burning of stubbles to allow the competition in favour of wheat. The actions of herbicides on weeds have been tested under conventional method of wheat sowing but new techniques of establishment of wheat revealed different types of weed flora with different density of weeds and their management practices are also different to the conventional system.

II. MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2013-2014 in the D-2 block of Norman E. Borlaug, Crop Research Centre (CRC) of G.B Pant University of Agriculture and Technology, Pantnagar (Uttarakhand). The soil was silty clay loam, with pH 7.2, medium in organic carbon (0.70%) and available nitrogen (217.5 kg/ha) and medium in available phosphorus (21.9 kg/ha) and available potash (190.3 kg/ha). Three establishment methods *viz.*, zero tillage with rice straw 3 t/ha (50 % of general straw yield), roto till seed drill and conventional tillage in the main plots and four weed management practices *viz.*, weedy check, two hand weedings (30 and 60 days after sowing), clodinafop-propargyl @ 60 g/ha and ready mix of clodinafop-propargyl 15% + metsulfuron methyl 1% @ 64 g/ha in the subplots were tested in split plot design with 3 replications. The experimental wheat crop was fertilized uniformly with 150:60:40 kg/ha of N, P and K, respectively. The variety PBW 502 was sown on 14 November, 2013. Herbicides were sprayed in the aqueous medium using 500 litres of water per hectare with the help of Maruti foot sprayer fitted with a flat fan nozzle. In hand weeded plots, weeds were removed with the help of *khurpi* .Weedy plot remained infested with the native weed population throughout the crop growing season. Density of *Phalaris minor* was recorded using the quadrate of 50 cm x 50 cm ($0.25m^2$) from the area marked for recording observations. The count was expressed as number of weeds per metre square.

III. RESULTS AND DISCUSSION

Weed flora

Nine weed species (grassy-1, BLWs-08) were recorded in the experimental field. Among these weed species, *Phalaris minor*, *Coronopus didymus*, *Chenopodium album*, *Medicago denticulata* and *Polygonum plebejum* were the dominant.

Phalaris minor was the most dominating weed species in the experiment. The dominance of *Phalaris minor* computed to the total weed population in weedy check was 100, 64.2, 69.4 and 80.8 per cent at 30, 60, 90 DAS and at maturity stage, respectively (Fig. 1, 2, 3). *Coronopus didymus* and *Polygonum plebejum* were the dominating weed species among BLWs, which altogether contributed 27.0, 19.4 and 3.8 percent at 60, 90 DAS and maturity, respectively to the total weed population in weedy plots of the experiment. The contribution of the remaining BLWs to the total weed population in weedy plots was 0.00, 4.1, 6.9 and 9.6 percent at 30, 60, 90 DAS and maturity stage, respectively. *Melilotus spp., Rumex dentatus, Lathyrus aphaca* and *Parthenium hysterophorus* were designated as "remaining BLWs" due to their less appearance in the experiment.

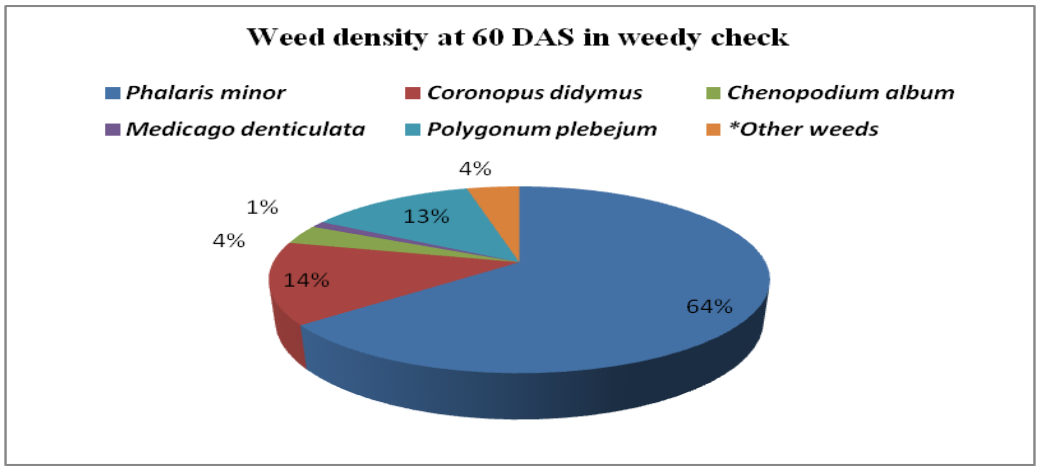

FIG. 1 WEED DENSITY (%) AT 60 DAS IN WEEDY CHECK

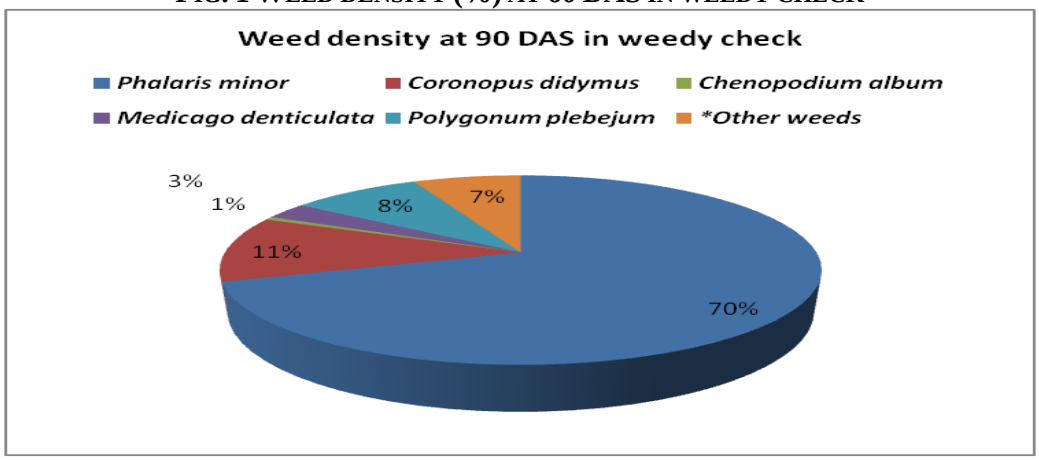

FIG. 2 WEED DENSITY (%) AT 90 DAS IN WEEDY CHECK

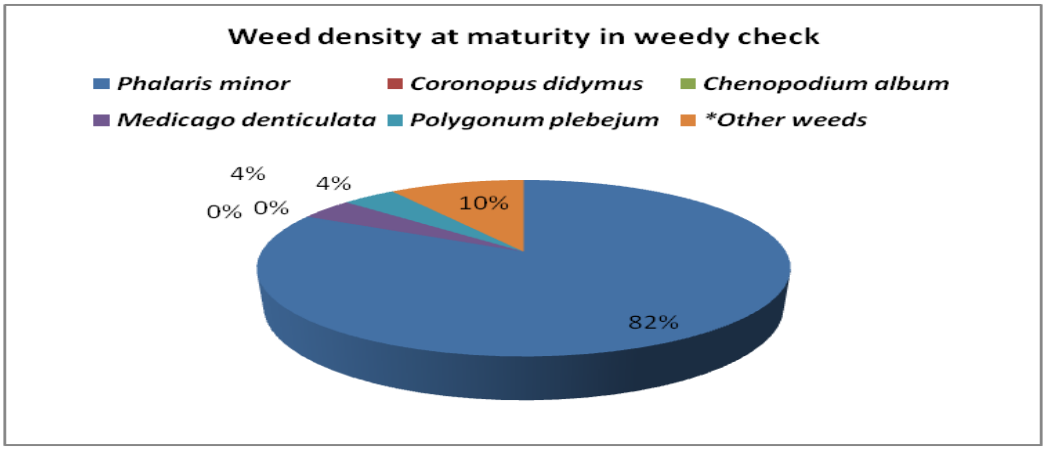

FIG. 3 WEED DENSITY (%) AT MATURITY STAGE IN WEEDY CHECK

Density of *Phalaris minor*

Density of *Phalaris minor* owing to different establishment methods was influenced significantly at all the stages of observation *i.e*. 30, 60, 90 DAS and at maturity stage. Density of *Phalaris minor* was highest under RTW followed by CTW and least in ZTW at 60, 90 DAS and maturity stage. CTW being at par with RTW recorded significantly higher density of *Phalaris minor* than ZTW at 30 DAS. Higher number of *Phalaris minor* under CTW and RTW might be due to better tilth and exposer of most of the weed seeds to upper soil layer. **Singh *et al.* (2001)** also confirmed the same finding as soil cover mix residue exerts its weed controlling function **(FAO, 2005)**. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha and clodinafop-propargyl @ 60 g/ha recorded complete control on *Phalaris minor* population at 60, 90 DAS and at maturity stage. Due to post emergence application of the herbicide, density of *Phalaris minor* was higher almost in each treatment at 30 DAS. The data revealed that ready mix of clodinafop-propargyl + MSM @ 64 g/ha and clodinafop-propargyl alone @ 60 g/ha were effective against grassy weeds. **Chhokar and Malik, (2002); Mohammed *et al.* (2007); Khalid *et al*. (2009)** reported the similar findings.

TABLE 1. EFFECT OF TREATMENTS ON PHALARIS MINOR DENSITY (NO/M2) AT VARIOUS STAGES OF THE CROP GROWTH

Treatments	*Phalaris minor* density (No/m^2)			
	30 DAS	60 DAS	90 DAS	At maturity
A. Establishment method				
Zero tilled wheat	0.00(0.00)	1.91(24)	1.25(6)	1.05(4)
Conventional tilled wheat	5.09(159)	2.10(34)	1.74(16)	1.63(13)
Roto till drilled wheat	5.03(154)	2.29(52)	1.92(29)	1.83(24)
SEm±	0.10	0.05	0.03	0.03
CD (5%)	0.40	0.18	0.10	0.11
B. Weed management practices				
Weedy	3.34(104)	4.49(95)	3.60(50)	3.41(42)
Two hand weeding	3.50(135)	3.92(51)	2.94(18)	2.59(13)
Clodinafop-propargyl @60g/ha	3.33(101)	0.00(0.00)	0.00(0.00)	0.00(0.00)
Ready mix of Clodinafop-propargyl + MSM @ 64 g/ha	3.33(101)	0.00(0.00)	0.00(0.00)	0.00(0.00)
SEm±	0.04	0.04	0.03	0.03
CD (5%)	0.10	0.11	0.09	0.10

Original values are given in parantheses

Establishment methods of wheat and weed management practices showed significant interaction effect on density of *Phalaris minor* at 60 and 90 DAS which is presented in Table 2 and Table 3. Alone application of clodinafop-propargyl @ 60 g/ha and ready mix of clodinafop-propargyl+MSM @ 64 g/ha recorded cent percent control on *Phalaris minor* under all the establishment methods of wheat. ZTW under twice hand weeding recorded significantly lower density of *Phalaris minor* than that of RTW and CTW along with two hand weedings. However, among weedy plots the highest density was recorded under RTW.

Density of *Phalaris minor* in weedy plots of ZTW was found to be 58.5% and 29.5% and 88.5% and 73.5% lower as compared weedy plots of RTW and CTW respectively at 60 DAS and 90DAS. Similar finding was also reported by **Gangwar *et al.*, 2006** where ZT reduced the density of *Phalaris minor* by 72.5% when compared to CT. Interaction table data revealed that clodinafop-propargyl @ 60 g/ha and ready mix of clodinafop-propargyl+MSM at 64 g/ha both are equally effective in controlling the *Phalaris minor* in all establishment methods of wheat at both (60 and 90 DAS) stages.

TABLE 2
INTERACTION EFFECT BETWEEN ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES ON DENSITY OF PHALARIS MINOR AT 60 DAS

Weed management practices / Establishment method	Weedy	Two hand weedings at 30 and 60 DAS	Clodinafop-propargyl @ 60 g/ha	Clodinafop-propargyl + MSM @ 64 g/ha
Zero tilled wheat	4.08(59)	3.58(35)	0.00	0.00
Conventional tilled wheat	4.43(84)	3.96(53)	0.00	0.00
Roto till drilled wheat	4.95(142)	4.19(65)	0.00	0.00
				CD (P = 0.05)
Sub plot at same level of main plot				0.19
Main plot at same or different level of sub plot				0.24

TABLE 3
INTERACTION EFFECT BETWEEN ESTABLISHMENT METHODS AND WEED MANAGEMENT PRACTICES ON DENSITY OF PHALARIS MINOR AT 90 DAS

Weed management practices / Establishment method	Weedy	Two hand weedings at 30 and 60 DAS	Clodinafop-propargyl @ 60 g/ha	Clodinafop-propargyl + MSM @ 64 g/ha
Zero tilled wheat	2.45(11)	2.54(12)	0.00	0.00
Conventional tilled wheat	3.77(42)	3.17(23)	0.00	0.00
Roto till drilled wheat	4.57(96)	3.09(21)	0.00	0.00
				CD (P = 0.05)
Sub plot at same level of main plot				0.15
Main plot at same or different level of sub plot				0.16

TABLE 4
EFFECT OF TREATMENTS ON PHALARIS MINOR DRY MATTER (G/M2) AT VARIOUS STAGES OF THE CROP GROWTH

Treatments	*Phalaris minor* dry matter (g/m^2) accumulation			
	30 DAS	60 DAS	90 DAS	At maturity
A. Establishment method				
Zero tilled wheat	0.00(0.00)	1.96(25.7)	1.22(7.4)	1.24(7.6)
Conventional tilled wheat	1.31(2.9)	1.86(22.4)	1.98(45.6)	2.01(47.6)
Roto till drilled wheat	1.44(3.2)	2.14(37.62)	1.99(72.0)	2.07(81.8)
SEm±	0.03	0.04	0.04	0.03
CD (5%)	0.13	0.14	0.17	0.13
B. Weed management practices				
Weedy				
Two hand weeding	0.82(1.68)	4.31(75.4)	4.67(156.8)	4.73(171.5)
Clodinafop-propargyl @60g/ha	1.07(2.72)	3.64(38.9)	2.27(9.97)	2.37(11.3)
Ready mix of Clodinafop-propargyl + MSM @ 64 g/ha	0.92(2.03)	0.00(0.00)	0.00(0.00)	0.00(0.00)
SEm±	0.86(1.77)	0.00(0.00)	0.00(0.00)	0.00(0.00)
CD (5%)	0.02	0.04	0.04	0.04
	0.07	0.12	0.12	0.12

Original values are given in parantheses

Dry matter accumulation of *Phalaris minor*

Dry matter accumulation of *Phalaris minor* owing to different establishment methods was influenced significantly at all the stages of crop growth. Dry matter accumulation of *Phalaris minor* was highest under RTW which was at par with CTW but significantly higher over ZTW at 30, 90 DAS and at maturity stage. RTW recorded highest dry matter accumulation by *Phalaris minor* followed by ZTW and CTW which were at par with each other at 60 DAS. The reason behind higher accumulation of dry matter of *Phalaris minor* was the higher number of population of *Phalaris minor* which is evident from the Table 9. **Sharma, *et al*. (2004)** also reported the similar findings.

Differences in dry matter accumulation of *Phalaris minor* owing to weed management practices were found significant at 30, 60, 90 DAS and at maturity stage. Ready mix of clodinafop-propargyl + MSM @ 64 g/ha and clodinafop-propargyl @ 60 g/ha recorded complete elemination in dry matter accumulation of *Phalaris minor* at 60, 90 DAS and maturity stage and hence zero impact on the wheat crop. Dry matter production of *Phalaris minor* was higher almost in each treatment at 30 DAS as the treatments were applied later due to rain . In case of hand weeding, both the weedings at 30 and 60 DAS showed higher dry matter accumulation of *Phalaris minor* due to non execution of hand weeding on time due to irrigation and rain. The presence of *Phalaris minor* under hand weeded plots owes to second flush of emergence of this weed

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