Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP1: 121-123

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(Special Issue- 1)
2nd International Conference
"Food Security, Nutrition and Sustainable Agriculture - Emerging Technologies"
(February 14-16, 2019)

Competitive ability of *Phalaris minor* and wheat (*Triticum aestivum* L.) At variable density

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Abstract
A field experiment was conducted at crop research farm, Department of Agronomy, college of agriculture, Selaqui, Dehradun during winter season of 2015-16. The data revealed that wheat crop sown at higher density (150 Kg/ha seed rate and 15 cm row spacing) gave maximum suppression affect on growth of *Phalaris minor* and produced significantly more dry matter, effective tillers and ultimately grain yield as compared to normal seed rate and spacing of wheat. The grain yield of wheat declined with increased density of *Phalaris minor* and maximum reduction of 59% in grain yield of wheat was observed at 320 plants/m^{-1} of this weed.

Keywords: Wheat, *Phalaris minor*, planting density, row spacing

Introduction
Wheat (*Triticum aestivum* L.) is a critical source of sustenance for a major portion of the world population. The crop productivity (2013) in India for wheat (3.15 t ha^{-1}) as compared to global averages of 3.26 t ha^{-1} (FAO 2016) and it provides 21% of the total food calories and 21% of the protein to more than 4.5 billion people in 94 developing countries. Weeds are an important obstacle to crop production, particularly in low-input and or organic systems and are notorious yield reducers (Saqib *et al.*, 2012). Weeds are undesirable on account of their competitive and allelopatheic behavior and providing habitants for harmful organisms (Zaman *et al.*, 2011) [9]. Weeds cause more loses to agriculture then all Pest (Gella *et al*., 2013) [4].
Number of weed species in wheat field varied country to country, 33 in Iran Buczek *et al*., (2011) [1]. Weeds are one of the major constraints of wheat production and weed control is the key factor in increasing yield Lopez-Granados, (2011) [5]. Javaid *et al.*, (2010) studied that the yield losses by six commonly occurring and most abundant weeds in wheat field *viz., Phalaris minor* Retz. *Rumex* L., *Coronopus didymus* (L.) Sm., *Medicago denticulate Willd*., *Chenopodium album* L., and *Poa annua* L. These weeds were grown with two commercially grown wheat varities *viz*., Inqalab 91 and Punjab 96 in 1:1 weed-crop ratio. Maximum yield losses of 76% in Inqalab 91 were caused by *Poa Annua* followed by 75% by *C. Didymus*, whereas other weeds caused 60-70% yield losses. In case of Punjab 96, maximum reduction was by *Chenopodium album* (23%), *Coronopus didymus* (10%) and *Poa Annua* (0%). Punjab 96 proved to be the comparatively resistant against weeds than Inqalab 91.
Sultana *et al*., (2012) [7] study the exest of four weed control regimes and four wheat varities on growth and yield of wheat crop this study revealed that the highest grain yield (5.09 t ha^{-1}) was obtained in weed free (w_1) followed by (two hand weeding) (4.89 t ha^{-1}) and the lowest grain yield (4.13 t ha^{-1}) was obtained in no weeding treatment (unweeded control). The present study was undertaken to know the effect of variable densities of *Phalaris minor* on grouth and yield of wheat crop.

Materials and Methods
The field investigation was conducted during winter season of 2015-16 at the Research area, Department of Agronomy, college of Agriculture, selaqui, Dehradun, Uttarakhand, which is located at (20.78"N, 52'27.08"E with 515.54m altitude) above sea leavel.

The soil of the experimental field was sandy loam in texture, medium in organic carbon and low in available nitrogen medium in available phosphorous, available potash and low in available zinc with alkaline in reaction. The experiment was laid out in split plot desion by keeping two seed rates (100 and 150kg ha^{-1}) and two row spacings (15cm and 22.5cm) of wheat crop in main plots and seven densities of *Phalaris minor* (0, 10, 20, 40, 80, 160 and 320 plants m^{-2}) in sub plots. The data on plant height and dry matter accumulation was recorded for *Phalaris minor* whereas the data on plant height, dry matter accumulation, effective tillers, spike length, number of grain per spike, thousand grain weight and grain and straw yield of wheat were recorded in the present investigation.

Results and Discussion

Table 1: Effect of variable densities of *Phalaris minor* on growth and yield of wheat crop

Treatment	Height of wheat plant (cm) DAS			Dry matter (q h^{-1}) DAS			No. of effective tillers	Yield Contributing characters of wheat			Grain yield of wheat
Seed rate (Kg h^{-1})	60	90	At harvest	60	90	At harvest		Spike length (cm)	Gran (No.)/Spike	1000 Grain weight (gm.)	Grain yield (q h^{-1})
100	7.88	46.63	66.2	7.77	44.57	76.2	258	8.1	37.99	44.3	41
150	8.37	48.35	66.5	8.88	47.04	90.1	287	8.27	39.21	45.1	44
CD (5%)	0.24	0.27	NS	0.11	0.3	7.2	12.6	0.1	1.12	0.79	0.89
Row spacing (cm)											
15	8.41	48.15	66.8	8.84	47.04	87.8	285	8.25	38.26	45.64	44
22.5	7.83	46.49	65.7	7.68	44.57	78.4	262	8.13	38.9	45.85	42
CD (5%)	0.16	0.2	0.88	0.07	0.3	7.2	12.6	NS	NS	NS	0.83
Weed density (*Phalaris minor* m^2)											
0	7.47	47.69	65.6	11.98	60.71	138.12	398	9.61	45.33	49.68	61
10	7.93	45.93	66.1	10.51	55.17	113.95	370	9.3	42.79	46.37	57
20	8.18	46.18	66.5	9.05	50.6	97.93	320	8.51	40.58	47.81	49
40	8.48	47.32	66.4	7.98	46.88	81.72	279	7.81	39.08	46.08	44
80	8.65	47.8	65.9	6.74	43.91	66.05	196	7.52	35.99	45.11	38
160	8.93	49.06	67.2	5.81	36.48	50.01	157	7.31	34.39	43.84	29
320	9.11	49.83	67.4	4.91	32.73	39.24	143	7.22	32.84	42.48	25
CD (5%)	0.23	0.17	NS	0.34	1.28	6.55	6.61	0.18	0.78	3.05	3.64
DAS = days after sowing											

Effect on *Phalaris minor:* The data presented in Table-1 revealed that sowing pattern of wheat affected the plant height of *Phalaris minor* significantly at 90 days after sowing and at harvest. At these stages the height of *Phalaris minor* was significantly reduced under 15 cm rows spacing in comparison to 22.5 cm row spacing. There was a significant increase in plant height of *Phalaris minor* as the density of it increased from 10 to 320 plants m^{-2} at all periodic stages of observation. Similarly the dry matter accumulation by *Phalaris minor* reduced significantly at higher seed rate (150 kg/h^{-1}.) of wheat at all stages except at 60 DAS. The reduction in the dry matter can be attributed to thick crop stand which offected more competion for space, nutrient, moisture and solar radiation (Merotto *et al*., 2009) [8].

Effect on Crop

Table 2: Effect of variable densities of wheat crop and *Phalaris minor* on growth of *Phalaris minor*

Treatments	Height of *Phalaris minor* (cm)			Dry matter of *Phalaris minor* (q ha^{-1})		
Seed rate (Kg h-1)	60	90	At harvest	60	90	At harvest
100	7.91	53.05	87.11	2.4	4.1	5.79
150	7.34	50.97	82.42	2.36	3.9	5.63
CD (5%)	0.44	0.79	3.87	NS	0.13	0.05
Row Spacing (cm)						
15	7.43	50.62	85.7	2.3	3.93	5.65
22.5	7.83	51.55	87.7	2.4	4.08	5.77
CD (5%)	NS	1.2	1.7	0.06	0.13	0.04
Weed density (*Phalaris minor*/m^2)						
0	0	0	0	1	1	1
10	6.87	49.11	85.6	2.31	2.43	5.25
20	7.33	50.33	87.03	2.55	3.1	5.13
40	7.91	51.09	87.58	2.9	4.21	6.1
80	8.33	55.42	88	3.11	5.03	6.7
160	8.61	53.67	88.53	3.33	5.7	7.6
320	8.82	54.53	88.76	3.49	6.34	8.6
CD (5%)	0.24	1	0.38	0.19	0.19	0.14

The perusal of data indicated that crop emergence was uniform under all the treatments except (Table- 2) some variation due to difference in seed rates of wheat. The dry matter accumulation by wheat crop was significantly more at higher seed rate (150kg/h^{-1}) as compared to 100kg seed rate per h^{-1}. At 60 and 90 DAS and at harvest the dry matter production with seed rate of 150 kg ha^{-1} increased to the tune of 12.5 per cent, 5.25 per cent, and 15.42 per cent respectively, over recommended seed rate of 100 Kg ha^{-1}. At 60 and 90 days after sowing and at harvesting 13.6 per cent, 5.25 per cent, and 10.7 per cent, respectively, more dry matter production was noticed under 15 cm row spacing in contrast

to 22.5 cm row spacing. The dry matter of 138.12qha^{-1} at harvest was recorded in the weed free treatment and the lowest of 39.24qha^{-1} was recorded in the highest *Phalaris minor* density of 320 plants m^{-2} and the reduction was to the extent of 71.58 per cent compared to the weed free plots.

The data in Table-1 further showed that crop sown with higher seed rate (150 Kg ha^{-1}) recorded significantly more number of effective tillers than recommended seed rate (100 Kg h^{-1}). Chaudhary *et al*., (2015) [2]. Also observed that Weed free treat ment recorded maximum effective tillers of 398 and lowest numbers of effective tillers of 143 were recorded in highest *Phalaris minor* density of 320 plants m^{-2}. The minimum density of *Phalaris minor, i.e.* 10 plants per square meter also reduced the effective tillers of wheat by 7 percent over weed free wheat crop Singh *et al.,* (2015) [6] also reported that there was a gradual decline in the number of fertile tillers from weed free plots to maximum wild oats density plots. Similarly higher seed rate of wheat 150kg/h^{-1} produced lengthy spikes, more number of grains and test weight as compare to 100 kg/h^{-1} seed rate. The increased density of *Phalaris minor* reduced the spike lengh, number, of grains and test weight of wheat and ultimately grain yield as compared to weed free treatment and maximum reduction was observed at 320plants/m^{-2} of *Phalaris minor*.

The data further reveals that crop sown at higher density of wheat (150 Kg ha^{-1}) gave significantly more grain yield compared to crop sown at recommended seed rate (100 Kg ha^{-1}) and the increase in the yield was to the tune of 7.3 per cent. (Table- 2) Similar findings were reported by Chaudhary *et al*., (2013).

Conclusion

The studies on the competitive ability of wheat and *Phalaris minor* in relation to their variable density revealed that higher density of wheat as well as *Phalaris minor* showed adverse effect on growth and development of each other. Higher density of wheat has suppressing effect on *Phalarise minor* and higher density of *Phalaris minor* has adverse effect on growth, development and yield of wheat crop.

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