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# Effect of sowing date, seed rate of wheat and different densities of little seed canary grass (*Phalaris minor* Retz.) on growth and productivity of wheat

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## ABSTRACT

Experiments conducted at Indian Agricultural Research Institute, New Delhi during 1998-99 revealed that late sowing (mid December) significantly reduced the productive tillers, spikelet per spike, grain per spike, 1000 grain weight and yield of wheat as compared to mid November sowing. The yield increase of wheat was 10.5-16.9% with 150 kg/ha seed rate of wheat in the plot with maximum *P. minor* infestation as compared to that (4.8-4.9%) with 100 kg/ha. Increasing the *P. minor* densities from 0 to 200 / m$^2$ significantly reduced leaf area of wheat at 60 DAS and 90 DAS, number of tillers at 60 DAS, ear bearing tillers, grain per spike, 1000 grain weight and ultimately the yield of wheat by 23.9% to 32.58%.

***Key words :*** Cultural management, *Phalaris minor*, Growth and productivity of wheat.

Rice-wheat system is an important, widespread and most remunerative cropping system contributing more than 70% to the national food basket. This system continues to hold the key to Indian food security. Out of several constrains concerning sustainability, the infestation of *P. minor* in wheat has been implicated as one of the reasons for stagnation in the productivity of rice-wheat system. This is considered as one of the most predominant and troublesome annual grassy weeds of wheat in India. Yield losses especially from weed *P. minor* alone are estimated at around 25-50% and in very severe cases, the losses may go upto 80% (Mehra & Gill, 1988; Malik *et al.* 1995). A shift from herbicide use alone for management of *P. minor* to an integrated approach would be more effective and sustainable besides being environmentally safe. Alternative strategies of weed management by modifying the crop weed ecosystem in favour of crop involving ecophysiological approaches may prove effective to reduce the menance of this weed. If sufficient growth margin in favour of the crop could be manipulated by changing the sowing time of wheat, the extent of infestation of this weed may be greatly reduced. Crop density also affects the competitive equilibrium between weeds and crops (Cudney and Hill, 1979). However, there are very few studies in which attempt has been made to analyse the competitive relationship with ecophysiological approach. Hence, the present experiment was conducted to study the effect of sowing dates and seed rates of wheat and different densities of *P. minor* on growth and productivity of wheat.

## MATERIALS AND METHODS

An experiment was conducted during the *rabi* season of 1997-98 and 1998-99 at the Farm of the Indian Agricultural Research Institute, New Delhi, India which is located at 28°35' N latitude and 77°12' E longitude at an altitude of 228 m above mean sea level. The soil of the experimental plot was sandy loam (typic ustochrepts; order inceptisol), medium in fertility (1164 kg total nitrogen, 19 kg available P and 218 kg available K per hectare) with pH 8.2. The combination of two sowing dates (mid November and mid December) and two seed rates of wheat (100 and 150 kg/ha) were assigned in main plots and five densitites of *P. minor* (0, 25, 50, 100 and 200 m$^{-2}$) in sub-plots of a split plot design with three replications.

In order to have sufficient little seed canary grass build up, the seeds were uniformly broadcasted before the final land preparation. *P. minor* seedlings were thinned out to the desirable weed densities according to the treatments in both the years by 35$^{th}$ day. Other associated weeds and canary grass were removed thereafter by hand pulling as and when emerged. Wheat crop was grown following the standard region based recommended agronomic practices. The leaf area of wheat and canary grass was determined by a LI 3100 leaf area meter. The number of fertile tillers, length of spike, grains per spike, 1000-grain weight and grain yield of wheat were recorded at maturity from 20 randomly selected plants.

## RESULTS AND DISCUSSION

### No. of tillers $m^{-2}$

Number of tillers of wheat was reduced in late sown wheat as compared to normal sown condition in both the years but it was significant only in the first year. Higher seed rate also significantly increased (16.0-17.7%) the number of tillers per unit area (Table 1). The number of tillers was decreased significantly with corresponding increase in the density of *P. minor* from 0 to 200 $m^{-2}$. Tiwari *et al.* (1984) also reported the similar effect of increased density of *P. minor* on tillers of wheat.

### Leaf area

Mid November sown crop recorded higher leaf area Index (LAI) as compared to mid December sown crop in all the stages except at 60 DAS in the second year, where it was not significantly different. The leaf area Index at 150 kg/ha seed rate was maximum at all the stages and it was significantly superior to 100 kg/ha seed rate (Table 1). 0 and 25 *P. minor* density $m^{-2}$ the wheat leaf area was not significantly different. The LAI at 200 *P. minor* $m^{-2}$ density was reduced by 20.4% and 32.4% o first year and 24.9% and 40.9% in the second year at 60 and 90 DAS, respectively as compared to weed free conditions.

### Dry matter production

The dry matter production of wheat at all the stages was reduced significantly when sowing ws done in mid December. Increase in seed rate from 100 to 150 kg/ha enhanced the dry matter production of wheat by 10.4 and 16.9% at 60 DAS and 3.7 and 7.7% at 90 DAS in 1997-98 and 1998-99, respectively (Table 1). Similar findings of higher dry matter production with increasing seed rate were also reported by Das *et al.* (1993).

### Yield and yield component

December sown crop, recorded significantly the reduced number of productive tillers, spikelet per spike, grain per spike and 1000 grain weight (Table 1) as compared to November sown crop. Thus under late sown condition, the reduce number of tillers, leaf area and dry matter production in the pre-anthesis period and lower number of ear bearing tillers (EBT), grain per spike, spike let per spike and 1000 grain weight in post anthesis period resulted in decrease in grain yield by 4.6-5.9%. Bagga and Tandon (1991) also reported similar results. Total number of tillers $m^{-2}$ increased with increase in seed rate. However, the extent of formation of effective tillers was higher with 100 kg seed rate than 150 kg seed rate. The spikelet and grain per spike were reduced significantly with 150 kg seed of wheat.

Increasing *P. minor* density affected all the yield components of wheat. Number of EBT was most affected (Table 2). There was a gradual decline in the number of EBT from weed free plot of maximum *P. minor* density plot, the reduction being 40 and 43% in the first and second year respectively. Besides, EBT, spikelets per spike, grains per spike and 1000-grain weight were also significantly reduced (Table 2). There was a progressive decrease in grain yield of wheat with increasing densities of *P. minor* as compared to weed free condition (Table 1). The yield loss in the maximum *P. minor* density plot was recorded to be 23.9% in the firs tyear and 32.58% in the second year. A number of research workers reported yield losses of wheat at different *P. minor* densities in varying environmental condition (Mehra and Gill, 1988; Malik *et al.*, 1995).

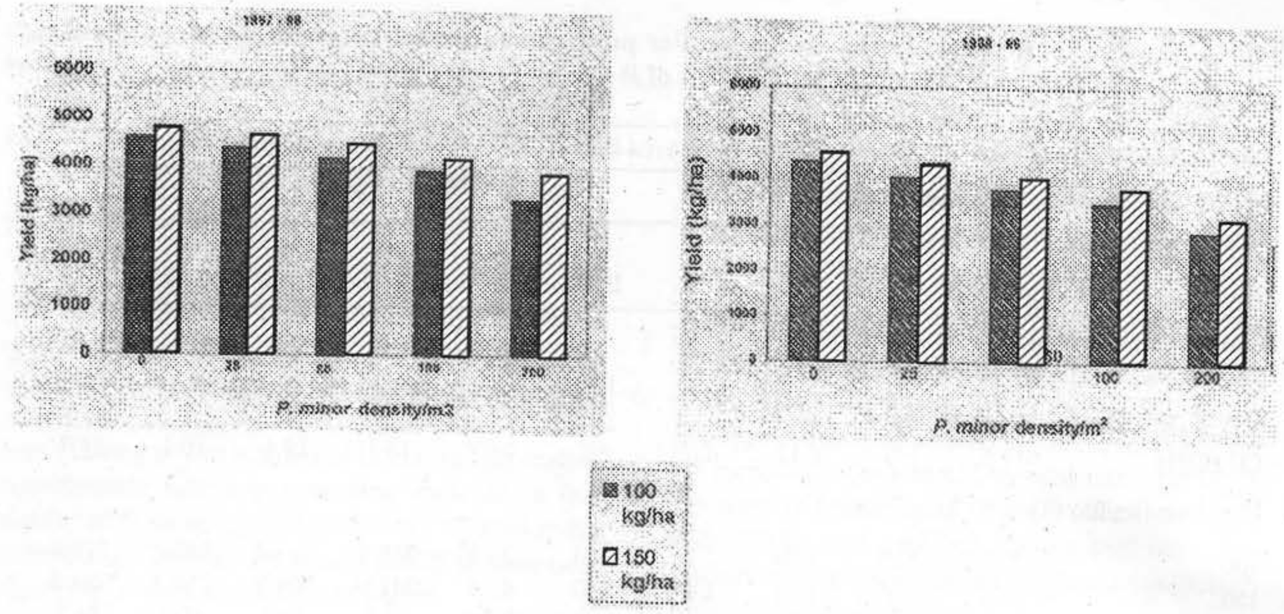
In weed free situation, increasing seed rate from 100 to 150 kg/ha did not appear advantageous as the marginal yield obtained was only 4.8-4.9%. However, in high *Phalaris* infested plots marginal yield increase with increasing seed rate from 100 to 150 kg/ha was 16.9% and 10.5% in the first and second year respectively (Fig. 1). Bhan (1987) also reported that increasing seed rate from 100 to 150 kg/ha significantly reduced the dry matter of weed in high weed density plots and higher grain yield of wheat.

**Table 1** Number of tillers, leaf area and dry matter production of wheat as influenced by sowing date, seed rate of wheat and different densities of *P. minor*

| Treatment | No. of tillers/m² | | Leaf Area Index | | | | Bdy matter production (g/m²) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1997-98 | 1998-99 | 1997-98 | | 1998-99 | | 1997-98 | | 1998-99 | |
| | | | 60 DAS | 90 DAS | 60 DAS | 90 DAS | 60 DAS | 90 DAS | 60 DAS | 90 DAS |
| **Sowing date (D)** | | | | | | | | | | |
| Mid. Nov. | 650 | 584 | 1.75 | 2.57 | 1.97 | 2.43 | 239.1 | 719.7 | 287.8 | 774.8 |
| Mid. Dec. | 596 | 552 | 1.56 | 2.40 | 1.78 | 2.08 | 220.2 | 664.5 | 243.8 | 738.1 |
| CD (0.05) | 37.2 | NS | 0.12 | 0.09 | NS | 0.09 | 13.1 | 19.4 | 10.1 | 34.7 |
| **Seed rate (kg/ha) (S)** | | | | | | | | | | |
| 100 | 577 | 522 | 1.58 | 2.30 | 1.81 | 2.13 | 218.3 | 679.4 | 245.1 | 728.0 |
| 150 | 669 | 614 | 1.73 | 2.67 | 2.02 | 2.39 | 241.0 | 704.8 | 286.5 | 784.2 |
| CD (0.05) | 37.2 | 36 | 0.12 | 0.095 | 0.15 | 0.096 | 13.1 | 19.4 | 10.1 | 34.7 |
| ***P. minor* density/m² (P)** | | | | | | | | | | |
| 0 | 726 | 680 | 1.86 | 2.97 | 2.20 | 2.87 | 262.6 | 867.6 | 313.9 | 985.3 |
| 25 | 699 | 649 | 1.78 | 2.65 | 2.09 | 2.52 | 242.0 | 745.8 | 281.8 | 829.8 |
| 50 | 640 | 578 | 1.60 | 2.47 | 1.87 | 2.20 | 230.9 | 685.2 | 266.0 | 749.4 |
| 100 | 560 | 490 | 1.56 | 2.32 | 1.76 | 2.00 | 215.6 | 625.8 | 248.3 | 657.3 |
| 200 | 490 | 443 | 1.48 | 2.00 | 1.65 | 1.69 | 197.3 | 535.7 | 219.1 | 559.0 |
| CD (0.05) | 25.9 | 29.4 | 0.10 | 149.0 | 0.119 | 0.125 | 10.7 | 31.4 | 17.9 | 30.8 |

**Table 2** Yield components and yield of wheat as influenced by sowing date, seed rate of wheat and different densities of *P. minor*

| Treatments | EBT | | Spikelets/spike | | Grains/spike | | 1000-grain weight (g) | | Grain yield (kg/ha) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1997-98 | 1998-99 | 1997-98 | 1998-99 | 1997-98 | 1998-99 | 1997-98 | 1998-99 | 1997-98 | 1998-99 |
| **Sowing date (D)** | | | | | | | | | | |
| Mid . Nov. | 447 | 364 | 17.09 | 16.05 | 41 | 39 | 42.89 | 40.72 | 4325 | 3979 |
| Mid. Dec. | 424 | 329 | 16.04 | 16.18 | 40 | 38 | 41.90 | 37.68 | 4127 | 3746 |
| CD (0.05) | 10.9 | 17.7 | 0.60 | NS | 0.99 | NS | 0.81 | 1.38 | 177.11 | 79.38 |
| **Seed rate (kg/ha) (S)** | | | | | | | | | | |
| 100 | 426 | 333 | 16.90 | 16.25 | 41 | 40 | 42.32 | 39.08 | 4057 | 3723 |
| 150 | 447 | 359 | 16.23 | 15.98 | 40 | 37 | 41.78 | 39.33 | 4394 | 4002 |
| CD (0.05) | 10.5 | 17.7 | 0.47 | 0.19 | 0.99 | 2.02 | NS | NS | 177.11 | 79.38 |
| ***P. minor* density/m² (P)** | | | | | | | | | | |
| 0 | 522 | 434 | 17.63 | 16.64 | 43 | 43 | 44.58 | 42.59 | 4697 | 4491 |
| 25 | 504 | 416 | 17.01 | 16.38 | 41 | 39 | 43.09 | 40.42 | 45.08 | 4213 |
| 50 | 455 | 348 | 16.55 | 16.06 | 40 | 38 | 41.00 | 38.66 | 4321 | 3926 |
| 100 | 386 | 285 | 16.05 | 15.86 | 38 | 37 | 40.75 | 37.61 | 4030 | 3657 |
| 200 | 314 | 249 | 15.57 | 15.62 | 37 | 34 | 39.91 | 36.71 | 3574 | 3027 |
| CD (0.05) | 18.3 | 16.6 | 0.30 | 0.15 | 0.95 | 0.88 | 0.80 | 0.73 | 67.43 | 88.12 |





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