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Economic threshold levels of little seed canary grass in wheat in north Bihar

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ABSTRACT

A field experiment was conducted under All India Coordinated Research Programme on Weed Control at Crop Research Centre of Rajendra Agricultural University, Bihar, Pusa, Samastipur during *rabi* season of 2004-05 and 2005-06 in calcareous sandy loam soil with an aim to evaluate the effect of different density of *Phalaris minor* on growth and yield of wheat. Higher density of *Phalaris minor* retrogressively affected plant height, spike length, crop biomass and grain yield of wheat. The level of reduction in wheat yield was 12 to 66% corresponding to an increase in density of *Phalaris minor* from 25 to 150/m^2. The present data showed the need for adoption of suitable weed management practices in wheat field with the density of *Phalaris minor* at 25/m^2 and above.

Key words : Economic threshold level, *Phalaris minor,* Wheat

Phalaris minor Retz. (canary grass) locally known as 'Bangehu' or 'Gullidanda', is a major weed in wheat and poses a serious threat for harnessing full yield potential of wheat in north Bihar. The weed was observed as more serious under rice-wheat cropping system, which is most popular crop rotation among farming communities of north Bihar as well as in Indo-Gangetic belt of India. Rice-wheat cropping systems occupy an area of 12 m/ha in India (Paroda *et al*. 1994) and contribute 40% to the food grain production of the country. There are many constraints to productivity, profitability and sustainability in this cropping system. Weed density is one of the major factors in determining the wheat yield as a result of the competition between weeds and wheat crop. *Phalaris minor* not only competes with growth factors of wheat crop but also forces the crop to lodge and as a result cause a reduction in wheat grain yield to the tune of 50% (Walia *et al.* 2001a). Morphological and physiological attributes of wheat crop also resembles with *Phalaris minor* and, therefore, further enhances the crop-weed competition (Balyan *et al.* 1991, Gogoi *et al.* 1991 and Mahajan *et al.* 2004). Till date, literatures on the magnitude of competitiveness of *Phalaris minor* with wheat crop in north Bihar are lacking. Keeping these points in view, the present investigation was undertaken with a view to find out the relationship between different densities of *Phalaris minor* and grain yield of wheat *vis-à-vis* the control measures be adopted.

MATERIALS AND METHODS

A field experiment was conducted during *rabi* season of 2004-05 and 2005-06 under All India Coordinated Research Programme on Weed Control at Crop Research Centre of Rajendra Agricultural University, Pusa, Samastipur, Bihar. The soil of the experimental plot was sandy loam and calcareous in nature, low in organic carbon (0.42%), low in available nitrogen (206.6 kg/ha), medium in phosphorus (22.5 kg/ha) and low in potassium (104.5 kg/ha) with pH of 8.7. To study the effect of different densities of *Phalaris minor* on performance of wheat, weed seeds collected during previous year were evenly broadcasted in experimental plots before the sowing of wheat seed and then covered with a thin soil layer for both the years. Wheat variety *HD 2733* was sown with row spacing of 22.5 cm in micro plots of 2 x 2 m with four replications in randomized block design at recommended dose of fertilizers (100 kg N/ha, 60 kg P/ha, 40 kg K/ha, and 25 kg Zn /ha). Different weed densities of *Phalaris minor* was maintained in the experimental plots by thinning out the extra seedlings and a total of six weed density level were kept in the whole experiment; 0, 25, 50, 75, 125, and 150 plants/m^2 for both the years. Other weeds and *Phalaris minor* which emerged later were removed. The dry weight of *Phalaris minor* from each treatment was recorded. The data on plant height, spike length, and grain yield of wheat were recorded in each year and the pooled data are presented here. The relationship between density of *Phalaris minor* and wheat yield and biomass was determined through exponential model:

$$Y = a \cdot e^{-bx} \quad (1)$$

Where, Y is the wheat grain yield (g/m^2) or wheat biomass (g/m^2); x is the density of *Phalaris minor* (m^2); 'a' and 'b' are empirical constant of the model. In the above model, 'a' indicates the wheat grain yield or wheat biomass in the total absence of *Phalaris minor* and 'b' indicates the rate of reduction in wheat yield or biomass

due to increase in density of *Phalaris minor*. The observed data on density of *Phalaris minor* and wheat grain yield or biomass were fitted in the above model through non-linear least square fitting procedure of Solver function of the spreadsheet programme.

RESULTS AND DISCUSSION

Successive increase in density of *P. minor* significantly reduced the plant height of wheat. Total biomass of *P. minor* in the experimental plots was found increased with the increase in its density and as a result the magnitude of competition with crop was also increased (Table 1). Consequently, the wheat grain yield and biomass were reduced as a result of the competitive effect of *Phalaris minor* with the crop. The level in reduction of wheat yield based on the pooled data was 12.41 to 65.77% over control corresponding to the weed density of 25 and 150/m^2, respectively. Such high reduction in yield and biomass of main crop might be due to the similarity in morphological appearance and canopy structure of *Phalaris minor* and wheat crop. The similar physiological and morphological attributes of wheat crop and the weed resulted in similar affinity towards the utilization of natural resources towards their final photosynthates. Therefore, the available soil nutrients, soil moisture, photosynthetically active radiation, *etc.* were equally distributed between these two plant species and resulted in reduction in wheat yield from its full potential. Reversely, wheat yield under lesser density of *Phalaris minor* showed comparatively higher yield due to more utilization of the environmental resources, which are directly related to source-sink relationship. Similar type of findings on the hindrance of yield of wheat crop due to infestation of weed with similar morphological appearance and canopy structure with main crop was reported by many workers (Mahajan *et al.* 2004 and Gogoi *et al.* 1991). Even, for other crops such as oat, rye grass, *etc.* similar type of reduction in main crop yield due to weed infestation has also been reported (Walia *et al*. 2001b and Singh *et al*. 2006).

The reduction in wheat grain yield and wheat biomass as a result of the increase in density of *Phalaris minor* were fitted well in the exponential model as mentioned in Eq [1]. The fitted curves along with the observed values are presented (Fig. 1). Fitting R^2 was 0.99 and 0.98, respectively for wheat biomass *vs Phalaris minor* density and wheat yield *vs Phalaris minor* density. The parameter 'a' indicates that full yield potential of wheat crop in the experimental plot was 247 g/m^2 (2.47 t/ha).

The experiment conducted at the Calciorthent soils of north Bihar quantified the reduction in wheat yield as a result of the competition due to *Phalaris minor*. It was found that a density of *Phalaris minor* of 25 plants/m^2 may be considered as the threshold weed density beyond which proper weed management practices should be adopted. The reduction in wheat yield with the density of *Phalaris minor* is also well fitted in exponential model, which may be further used for any crop-weed competition study in the region.

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Table 1. Effect of different density of *Phalaris minor* on growth and yield of wheat crop (pooled data of two years)

Density of *Phalaris minor* (no./m^2)	Plant height (cm)	Spike length (cm)	Weed biomass (g/m^2)	Crop biomass (g/m^2)	Grain yield (g/m^2)	Yield reduction (%)
0	98.5	9.9	0.0	392	242	-
25	88.2	8.4	4.30	323	212	12.41
50	79.5	8.2	5.62	283	182	24.82
75	72.2	8.0	6.58	245	163	32.57
100	68.5	7.9	7.05	206	141	41.78
125	65.4	7.8	7.25	173	112	53.88
150	63.6	7.6	7.48	154	83	65.77
LSD (P = 0.05)	2.3	0.2	0.35	392	242	-

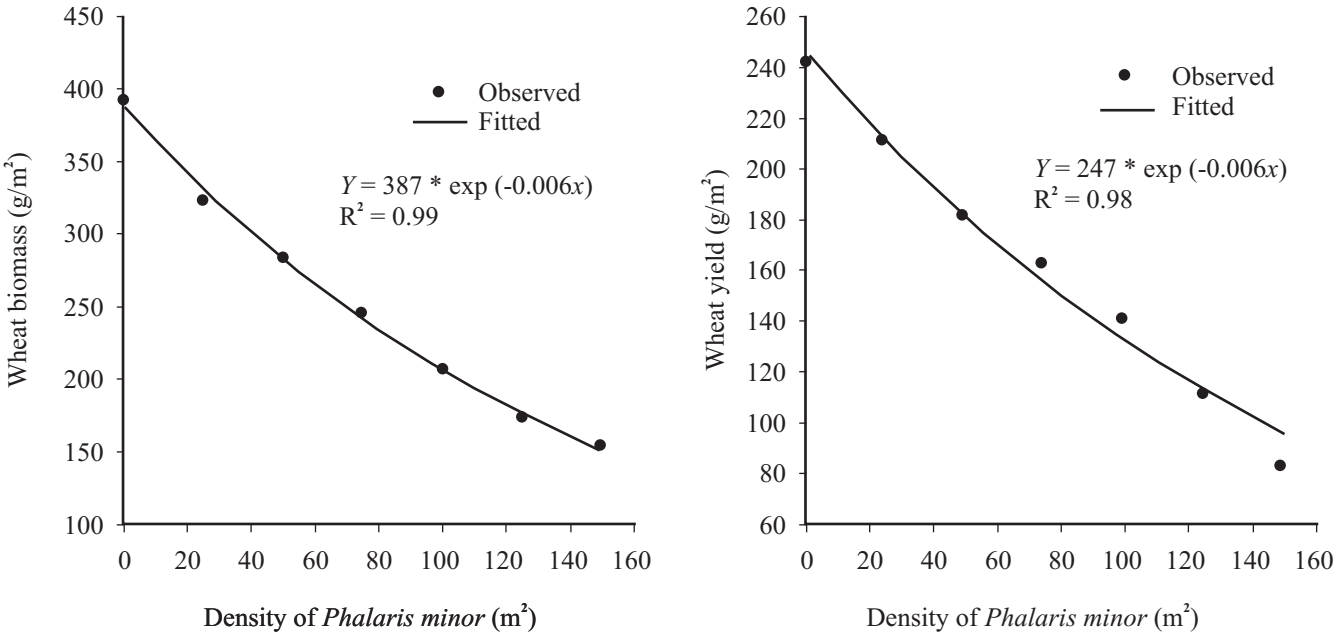

Fig. 1. Observed and fitted value of wheat yield and biomass corresponding to different density of *Phalaris minor* (fitted values were computed according to the exponential model and corresponding parameters are given inside the graph).

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