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Standardization of sowing time and nitrogen dose for wheat (*Triticum aestivum* L.) in hilly region of West Bengal

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ABSTRACT

A field experiment was conducted during the rabi season of 2016-17 at the Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong to standardize the sowing time and level of nitrogen application for wheat (cv. PBW 343) cultivation in hilly region of West Bengal. The analyzed data revealed that the grain yield and yield attributing characters shows better result with earlier sowing and with increased nitrogen level. Sowing at 1st November resulted significantly higher grain yield (4.97 t ha^{-1}) of wheat over 15th November and 1st December sowing. Application of nitrogen at 150 kg ha^{-1} produced maximum grain yield (5.25 t ha^{-1}), however, it was at par with nitrogen at 125 kg ha^{-1} and 100 kg ha^{-1}.

***Keywords*:** Nitrogen level, time of sowing, wheat, yield

Globally, wheat is one of the most important human food grains and it provides nourishment to a large number of world populations. Wheat (*Triticum aestivum* L.) is grown in an area of 30.17 million hectares with a total production of 91.53 million tonnes at an average yield of 3033 kg ha^{-1} in India (DAC, 2016). In Hill Zone of West Bengal, wheat is an important *rabi* cereal crop covering 709.0 ha of area but the productivity is under national average hitherto. The lower productivity under this zone could be exacerbated by the fact that the time of sowing and harvesting differs in different agro-climatic regions due to climatic variations which is responsible for varying growing period that ultimately leads to difference in potential yield. Hence, optimum sowing time needs to be standardized under this zone for higher productivity.

The key role played by nitrogen fertilizer in world cereal production is now widely recognized, and often an important limiting factor for productivity of cereals (Jan *et al*., 2007). Globally, the nitrogen fertilizer use has been increased seven folds since last five decades and strongly enhanced the crop yields (Dobermann and Cassman, 2002). The recovery of fertilizer nitrogen in crop production is nearly 50 per cent (Smil *et al*., 1999). The poor recovery of nitrogen fertilizer increases input cost to the farmers as well as environmental pollution. Hence, efficient nitrogen management with respect to economic production is very crucial while maintaining crop yield. With this background in view, the present investigation was theefore purposively undertaken to study effect of time of sowing and nitrogen management on yield contributing characters and the performance of wheat.

A field experiment was conducted in Regional Research Station (Hill Zone), Uttar Banga Krishi Viswavidyalaya, Kalimpong (latitude 27°312 N, longitude 88°282 E and altitude 1097m of the experimental site) during *rabi* season of 2016-17. Treatments were arranged in split-plot design with four (4) replications. Three main-plot treatments as three (3) dates of sowing: 1st November (D_1), 15th November (D_2) and 1st December (D_3) and seven (7) sub-plot treatments as nitrogen level were taken for this experiment: Control (T_1), FYM @ 5 t ha^{-1}(T_2), N @ 50 kg ha^{-1}(T_3), N @ 75 kg ha^{-1}(T_4), N @ 100 kg ha^{-1} (T_5) and N @ 125 kg ha^{-1} (T_6) and N @ 150 kg ha^{-1}(T_7). The popular wheat variety 'PBW 343' was sown with a row spacing of 22.5 cm. The individual plot size was 20 m^2 (5 × 4m). Phosphorus and potassium were given to all the treatments in similar quantity of 50 kg ha^{-1} of P_2O_5 and 25 kg ha^{-1} of K_2O, respectively. Half dose of nitrogen (granular urea), full dose of phosphorus (SSP) and potassium (MOP) were applied at basal in all the treatments except T_2 where full dose of FYM along with full dose of phosphorus and potassium were applied during land preparation. The rest half amount of nitrogen was applied in two splits as top dressed in all the treatments except T_2. Treatment effects on wheat yield, yield attributing parameters were recorded and grain protein content (Jackson, 1973; Sadasivam and Manickam, 1996) was assessed.

Statistical assessment of this experiment was performed by the analysis of variance (ANOVA) for split-plot design on the guidelines given by Gomez and Gomez (1984). The standard error of mean (SEm ±) and the value of LSD were indicated in the table to compare the difference between the mean values.

Effect of sowing date

Results shows that the significantly highest number of tillers m^{-2} (325.1), spikelets ear^{-1} (16.05), grains spike^{-1} (47.38), 1000-grain weight (40.05 g), grain

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Table 1: Influence of sowing time and nitrogen dose on yield attributing characters of wheat (PBW 343) during *rabi* 2016-17

Treatments	Plant height (cm)	Tillers m^{-2}	Spikelets ear^{-1}	Grains $spike^{-1}$	Spike length (cm)	1000-grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	Grain protein content (%)
Sowing time										
D_1	103.90	325.10	16.05	47.38	7.84	40.15	4.97	7.86	38.7	11.67
D_2	101.13	311.33	15.33	45.70	7.58	39.91	4.77	7.62	38.5	11.61
D_3	98.25	277.54	14.68	43.63	7.47	39.77	4.21	7.39	36.3	11.48
SEm (±)	**0.87**	**4.41**	**0.23**	**0.54**	**0.07**	**0.08**	**0.05**	**0.06**	**0.05**	**0.10**
LSD (0.05)	**2.62**	**13.23**	**0.69**	**1.61**	**0.20**	**0.23**	**0.14**	**0.19**	**0.14**	**0.30**
Nitrogen levels										
T_1	95.3	253.7	13.77	40.9	7.31	39.79	3.91	7.12	35.4	11.18
T_2	100.2	294.1	14.67	43.6	7.53	39.97	4.45	7.38	37.6	11.50
T_3	98.1	276.7	14.21	42.2	7.45	39.85	4.22	7.19	37.0	11.31
T_4	101.8	305.6	15.27	45.4	7.61	39.92	4.49	7.49	37.5	11.62
T_5	102.8	322.6	16.24	48.3	7.75	40.04	5.03	7.95	38.8	11.69
T_6	104.6	337.2	16.64	49.5	7.86	40.01	5.19	8.07	39.1	11.84
T_7	105.1	342.9	16.67	49.1	7.89	40.01	5.25	8.18	39.1	11.96
SEm (±)	**1.10**	**7.26**	**0.39**	**0.98**	**0.06**	**0.02**	**0.11**	**0.15**	**0.16**	**0.10**
LSD (0.05)	**3.28**	**21.72**	**1.18**	**2.93**	**0.19**	**0.07**	**0.32**	**0.45**	**0.49**	**0.31**

protein content (11.48%), grain (4.97 t ha^{-1}) and straw (7.86 t ha^{-1}) yield were obtained when wheat was shown on 1st November compared to other dates of sowing (Table 1). While 1st December sowing of wheat gave the lowest plant height (98.25cm), number of tillers m^{-2} (262.45), grain (4.11 t ha^{-1}) and straw (7.40 t ha^{-1}) yield, this could be exacerbated by the fact of proper uncongenial environmental factors like temperature (Fig. 1). A similar trend was observed by Devi *et al*. (2011) in Egypt, and according to him plant height, number of tillers m^{-2}, number of spikelets ear^{-1}, number of grain $spike^{-1}$, 1000-grain weight and grain yields of wheat were produced more when seed was sown in 15th November compared to late sowing. Similar type of result is also observed by Nizamuddin *et al*. (2014) and Khosravi *et al*. (2010) as wheat yield was reduced gradually by delayed sowing.

Effect of nitrogen levels

Nitrogen application had a significant effect on yield attributing characters, yield and grain protein content (Table 1). It is evident from the results that plant height, number of tillers m^{-2}, number of spikelet'sear^{-1}, number of grains $spike^{-1}$, spike length, 1000-grain weight, grain yield, straw yield, harvest index were increased significantly by increasing nitrogen level concomitantly up to100 kg ha^{-1}. This result was in conformity with the findings of earlier workers (Das and Mitra, 2011). Nitrogen @ 100 kg ha^{-1} was more significantly effective in increasing yield of grain and straw than 125 and 150 kg N ha^{-1} (Table 1). This might be due to the effective use of nitrogen in metabolism process and meristematic process which improved the growth characters and yield attributes contributed for significant increase in wheat grain and straw yield. Increasing the application of nitrogen level collaterally increase grain protein percentage and attained maximum with 150 kg N ha^{-1} (11.96%) and the value is at par with 125 kg N ha^{-1} (11.84%). Campillo *et al.* (2010) also reported similar type of result. Full expression of yield components depends on adequate supplies of both assimilate and N to ears during their fast growth period and the adequate N availability increases tiller m^{-2} and grains ear^{-1} due to increased photoassimilate supply during post-anthesis period (Rathore *et al*. 2016).

The results of this study suggest that time of sowing and optimum dose nitrogen application are important factors to determine the wheat yield. The highest values of number of tillers and spikes m^{-2}, 1000- seed weight, were obtained when wheat was sown on 1st November. Delay in sowing beyond first week of November caused severe reduction in tillers m^{-2}, spikelets ear^{-1}, grains $spike^{-1}$, 1000-grain weight and yield. Increasing nitrogen level significantly increased yield and yield components

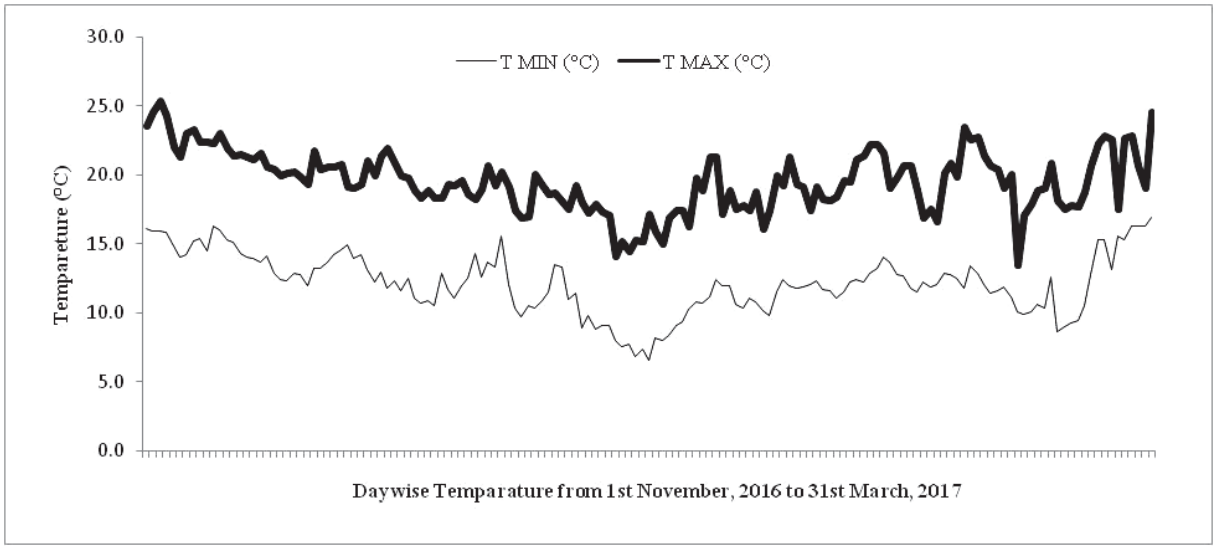

Fig. 1: Fluctuation of maximum and minimum temperature during the entire growth period

compared with other tested levels. The application of N @ 100 kg ha^{-1} gave the highest grain yield, straw yield and 38.75 per cent harvest index; being statistically at par with 125 kg N ha^{-1} as well as 150 kg N ha^{-1}. Therefore the results of these studies suggest that time of sowing and optimum amount of nitrogenous fertilizer application are very important factors to determine the yield. So it can be recommended to the farmers to sow seeds on 1st November and apply 100 kg N, 50 kg P_2O_5 and 25 kg K_2O ha^{-1} for successful wheat cultivation under hilly regions of West Bengal.

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