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Effect of time of sowing nitrogen and zinc management on growth attributes of wheat (*Triticum aestivum* L.)

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Abstract
To know the effect of time of sowing, nitrogen, and zinc management on the wheat crop, an experiment was carried out at the research farm of the Institute of Agricultural Sciences, BHU, Varanasi during the *rabi* seasons of 2018-19 and 2019-20. The treatments were arranged in a split-plot design involving three replications. The main plot was constituted of two factors i.e., Time of sowing and Nitrogen management. The subplot had one factor i.e., Zinc management. Time of sowing had two levels i.e., D_1: sowing in the second fortnight of November and D_2: sowing in the first fortnight of December. Nitrogen management had also two levels i.e., N_1: 150 kg ha^{-1} Nitrogen [75 kg basal+37.5 kg at Z20 (main shoot only) +37.5 kg at Z37 (flag leaf visible)] and N_2:150 kg ha^{-1} Nitrogen [70 kg basal+35.4 kg at Z20 (main shoot only) +35.4 kg at Z37 (flag leaf visible) + 9.2 kg as 2% urea application at Z60 (beginning of anthesis stage)]. The subplot zinc consisted of four levels i.e., Z_1: 0 kg ha^{-1} Zinc (No Zinc), Z_2: 5 kg ha^{-1} Zinc as basal, Z_3: 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$, H_2O spray Z31 (Stem elongation) + 0.50% at Z75 (Milking), Z_4: 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$, H_2O spray at Z60 (Anthesis) + 0.50% at Z85 (Dough stage). According to the results of the afore mentioned comprehensive study, wheat should be planted in the second fortnight of November with 150 kg ha^{-1} Nitrogen [75 kg basal + 37.5 kg at Z20 (only the main shoot) + 37.5 kg at Z37 (flag leaf visible)] and 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$, H_2O spray at Z31 (stem elongation) + 0.50% at Z75 (milking) (Z3).

Keywords: Time of sowing, foliar application, nitrogen, zinc

1. Introduction

India, a country in south Asia, produced roughly 3.5 thousand kg of wheat per hectare in the fiscal year 2021. Since the fiscal year 2015, the yield of wheat has steadily increased. One of the primary cereal crops in the nation, after rice, is wheat. Farmers have had trouble in recent years despite government efforts to improve practices. Excessive rains causing flooding, droughts brought on by erratic heat waves, as well as the recent economic downturn, have created difficult conditions. Significant wheat-producing areas like Uttar Pradesh, Madhya Pradesh, Haryana, and Punjab were impacted by temperature changes and continuously rising pollution levels. How much technology and chemical advancement in agriculture can contribute to the maintenance of a sustainable crop is yet unknown. (Statista Research Department, 2022). Rice-wheat cropping system leads to delayed sowing of wheat in the Indian context. Late sowing of winter wheat can result in unfavorable weather conditions, such as low temperatures particularly during vegetative growth period, which can result in low percentage of seed germination, decreased tillering capacity, and few plants (Borras-Gelonch *et al.*, 2012; Dreccer *et al.*, 2013) [2, 3]. Since nitrogen is a crucial component of nucleotides, proteins, chlorophyll, and enzymes, it plays a role in many metabolic processes that have an immediate impact on the total life cycle of plants. This increased growth and yield can be attributed to the application of nitrogen fertilizer (Mengel and Kirkby (1996) [4] and Chaturvedi, 2006) [5]. Split application of nitrogen leads to less nitrogen loss and increased absorption by the plant. To ensure that the plant has access to sufficient N later in the growing season, it gives them the flexibility to offer plants with little N during the initial part of the growing season (Graham, 2020) [6]. The risk of zinc deficiency affects at least 25% of the world's population (Wang, 2012) [7]. According to Li *et al.*, (2015) [8] foliar Zn treatment considerably increased the Zn bioavailability in wheat grain and flour both.

2. Material and Methods

Field experiments were carried out during *rabi* seasons of 2018-19 and 2019-20 at the agriculture research farm of the Institute of Agricultural Sciences, BHU, (U.P.), India, which comes under semi-arid region and is subjected to extremes of weather conditions., in Eastern Uttar Pradesh, India. In a semi-arid zone with maximum and mean temperature ranges from 27.3 °C to 41 °C in 24 standard weeks in summer and 21.9 °C to 3.9 °C in 52 standard weeks during winter in 2018-19 while a higher range of temperature from 27.1 °C to 43.8 °C was observed in 24 standard weeks in summer and lower temperature 13.6 °C and 7.0 °C observed in 52 standard weeks during 2019-20. Materials used in the study were two levels of time of sowing, namely, (D_1) sowing in the second fortnight of November, (D_2) sowing in the first fortnight of December, and two levels of nitrogen treatment, namely (N_1) 150 kg ha^{-1} Nitrogen [75 kg basal + 37.5 kg at Z20 (main shoot only) + 37.5 kg at Z37 (flag leaf visible)] and (N_2) 150 kg ha^{-1} Nitrogen [70 kg basal + 35.5 kg at Z20 (main shoot only) + 35.4 kg at Z37 (flag leaf visible) + 9.2 kg as 2% urea application at Z60 (beginning of anthesis stage)]. The time of sowing and nitrogen management were put under main plot and four zinc management treatments (Z_1) Control i.e.,0 kg Zn ha^{-1}, (Z_2) 5 kg ha^{-1} Zinc as basal, (Z_3) 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$ spray at Z31(stem elongation) + 0.50% at Z75 (milking), (Z_4) 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$ spray at Z60 (Anthesis) + 0.50% $ZnSO_4$ spray at Z85 (Dough stage) as subplot treatment. The experiment followed a split-plot design. The design used was a split-plot design with three replicates.

Table 1: The table shows the effect of time of sowing, nitrogen, and zinc management on plant height at 30, 60, 90 DAS and harvesting stage in wheat

Treatments	Plant height 30 DAS		Plant height 60 DAS		Plant height 90 DAS		Plant height Harvest	
	2018-19	2019-20	2018-19	2019-20	2018-20	2019-20	2018-19	2019-20
Time of sowing								
D1	19.765	19.908	56.393	56.857	80.947	84.420	92.990	93.782
D2	17.312	17.294	51.023	51.862	73.752	75.083	84.582	86.244
SEm ±	0.171	0.111	0.495	0.530	0.674	0.886	0.395	1.009
LSD (P = 0.05)	0.592	0.385	1.711	1.833	2.332	3.067	1.365	3.493
Nitrogen management								
N1	18.813	18.672	54.030	55.273	78.515	81.173	85.671	87.021
N_2	18.265	18.530	53.387	53.447	76.184	78.329	91.901	93.005
SEm ±	0.171	0.111	0.495	0.530	0.674	0.886	0.395	1.009
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS	1.365	3.493
Zinc management								
Z1	17.799	17.999	51.744	52.271	70.794	72.690	84.801	85.939
Z2	19.011	19.154	56.324	56.485	78.940	81.412	87.980	88.926
Z3	18.700	18.572	53.440	54.371	82.528	87.444	97.065	98.397
Z4	18.644	18.679	53.326	54.312	77.137	77.459	85.297	86.790
SEm ±	0.217	0.248	0.542	0.464	0.682	0.779	0.600	0.856
LSD (P = 0.05)	0.635	0.725	1.583	1.356	1.991	2.273	1.752	2.498

D_1-Second fortnight of November, D_2- first fortnight of November,
N_1-150 kg ha^{-1} Nitrogen [75 kg basal+37.5 kg at Z20 (main shoot only) +37.5 kg at Z37 (flag leaf visible)],
N_2-150 kg ha^{-1} Nitrogen [70 kg basal+35.4 kg at Z20 (main shoot only) +35.4 kg at Z37 (flag leaf visible) + 9.2 kg as 2% urea application at Z60 (beginning of anthesis stage)]
Z_1-0 kg ha^{-1} Zinc (No Zinc), Z_2-5 kg ha^{-1} Zinc as basal, Z_3- 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$ spray Z31 (Stem elongation) + 0.50% at Z75 (Milking), Z_4- 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$ spray at Z60 (Anthesis) + 0.50% at Z85 (Dough stage)

Table 2: Shows the effect of time of sowing, nitrogen, and zinc management on leaf area index of wheat plant at 30, 60 and 90 days after sowing

Treatments	Leaf area index 30 DAS		Leaf area index 60 DAS		Leaf area index 90 DAS	
	2018-19	2019-20	2018-19	2019-20	2018-20	2019-20
Time of sowing						
D1	0.770	0.759	3.038	3.168	3.432	3.874
D2	0.574	0.594	2.276	2.460	2.815	3.212
SEm ±	0.007	0.006	0.100	0.080	0.064	0.075
LSD (P = 0.05)	0.025	0.022	0.346	0.277	0.220	0.261
Nitrogen management						
N1	0.683	0.681	2.828	2.906	3.203	3.543
N_2	0.661	0.672	2.486	2.721	3.044	3.544
SEm ±	0.007	0.006	0.100	0.080	0.064	0.075
LSD (P = 0.05)	NS	NS	NS	NS	NS	NS
Zinc management						
Z1	0.588	0.614	2.198	2.530	2.765	2.977
Z2	0.721	0.732	3.116	3.128	3.308	3.564
Z3	0.689	0.692	2.953	2.889	3.303	4.077
Z4	0.691	0.668	2.362	2.707	3.118	3.555
SEm ±	0.033	0.028	0.094	0.054	0.047	0.082
LSD (P = 0.05)	0.096	0.083	0.275	0.158	0.137	0.239

Sowing was done on 30th November and 14th December during both years 2018-19 and 2019-20, respectively. Nitrogen fertilizer in form of urea at a rate of 150 Kg ha^{-1} was applied as per the treatments. Phosphorus and potassium were applied at the rate of 60 and 60 kg ha^{-1} as basal application, uniformly to all plots and two irrigations were applied according to the requirement, and all other agronomic practices were carried out. The observations were recorded for, plant height and leaf area index using standard procedures like meter scale, leaf area meter, and SPAD meter, respectively. Growth stages were determined using Zadoks scale (Zadoks *et al.*, 1974) [9]. The results were analyzed using standard procedures.

3. Results

3.1 Plant height

The data shown in table no. 1 shows the effect of treatments on plant height. The effect of time of sowing on plant height was significant throughout the crop cycle up to harvest. Plots sown in the second fortnight of November gave higher plant height as compared to the plots sown in the first fortnight of December.

The Effect of nitrogen management remained non-significant during observation up to 90 days after sowing but was found to be significant at 90 days after sowing and at the time of harvest when nitrogen was applied @ 150 kg ha^{-1} Nitrogen [70 kg basal+35.4 kg at Z20 (main shoot only) +35.4 kg at Z37 (flag leaf visible) + 9.2 kg as 2% urea application at Z60 (beginning of anthesis stage)].

Among zinc management, the lowest plant height was observed in the control plot. Basal application of zinc at the rate of 5 kg ha^{-1} gave higher plant height as compared to other treatments consisting of basal and foliar application of zinc at 30 and 60 day after sowing. Zinc sulfate application @ 1.7 kg ha^{-1} Zinc as basal + 0.50% $ZnSO_4$ spray at Z31(stem elongation) + 0.50% at Z75 (milking) gave higher plant height than other treatments of zinc at 60, 90 days after sowing and at harvest.

The interaction effect of nitrogen and zinc management and time of sowing and zinc management on plant height was found to be significant though out the life cycle except 30 days after sowing. N_2 along with Z_3 gave a higher value of plant height. Interaction effects of time of sowing and nitrogen management, nitrogen and zinc management, and time of sowing and zinc management on plant height were found to be significant at harvest.

3.2 Leaf area index

The data shown in table no. 2 shows the effect of treatments on leaf area index. The effect of time of sowing remained significant in 30, 60 as well as 90 days after sowing. The sowing in the second fortnight of November showed a maximum leaf area index in each observation. Nitrogen treatment remained nonsignificant during all three observation. The leaf area index was observed to be the lowest in the control plot where no zinc was applied. Leaf area index was observed to be the highest in the case of zinc treatment where zinc was applied @ 5 kg ha^{-1} as a basal application for 30 and 60 days after sowing and 60 and 90 days after sowing leaf area index was found to be the maximum in Z3. The interaction effect of time of sowing and zinc management and nitrogen and zinc management was found to be significant (except 30 days after sowing) up to the final observation at 90 days after sowing.

Table 3: Table shows the interaction effects of treatments on plant height and leaf area index.

	Plant height (cm)		Leaf area index	
Interaction	**2018**	**2019**	**2018**	**2019**
A*B	S (at Harvest)	S (at Harvest)	NS	NS
A*C	S (except 30 DAS)	S (except 30 DAS)	S (except 30DAS)	S (except 30 DAS)
B*C	S (except 30 DAS)	S (except 30 DAS)	S (except 30 DAS)	S (except 30DAS)
A*B*C	NS	NS	NS	NS

4. Discussions

Early sowing produces larger yields than late sowing because of the longer period, which has an impact on wheat growth, yield, and quality (Sattar *et al.*, 2010) [10]. The leaf area still is not large enough to support the seedling's necessary growth in response to a rise in temperature in later growth stages and low temperature also slows down the rate of leaf development, which could result in a reduction in LAI and plant height (Warrington & Kanemasu, 1983, Sattar *et al.*, 2010) [11, 10]. This could be the reason for the lower leaf area index and plant height noticed in plots sown in the first fortnight of December which is lower than crops sown in the second fortnight of November in the current study. Among the two levels of nitrogen, initial growth was not affected by reducing 7.1 kg of nitrogen in the first 30 days of growth in the case of N_2 treatment. 70 kg basal and 35.4 kg top dressing of N_2 was capable enough to give a result comparable to N_1. During later growth phases, after 2% urea foliar application, growth was compensated and gave more increase in height as compared to N_1 because of increased absorption, utilization of nitrogen, and less volatilization and leaching loss through foliar application.

Reductions in plant height and leaf size are the most recognizable responses of wheat plants to zinc shortage (The Zinc Nutrient Initiative, 2016). So, zinc applied only as basal at the rate of 5 kg ha^{-1} gave higher plant height and leaf area up to 60 days after sowing as compared to others. Because zinc deficiency in early phases causes stunting, (Imtiaz *et al.*, 2003) [12], zinc application gave remarkable change in height. Due to the dilution effect of zinc in the plant, the effect of zinc reduces in later growth stages. So, the foliar application is an option, in that case, to supplement nutrients to maintain growth throughout the life cycle which was marked in the current study in Z3. Nitrogen and zinc interaction enhanced the growth. Nitrogen and zinc are well known to be helpful in heat stress tolerance of crops which was also seen in the study and the interaction effect among them were found to be significant. It is well-known that zinc has a protective impact on biological membranes against oxidative and peroxidative damage, loss of plasma membrane integrity, and membrane permeability alteration (Bettger and Odell, 1981) [14].

5. Conclusion

The effect of time of sowing was significant and plant height and leaf area index were observed to be the maximum in the second fortnight of November in both years. The nitrogen management which included urea as a foliar spray during the anthesis stage of wheat gave significantly more leaf area index and height than other treatments. Zinc application as 1.7 kg Zn ha^{-1} basal along with foliar spray @ 0.5% $ZnSO_4$ at stem elongation stage and milking stage gave a maximum result in case of both plant height and leaf area index. The combination of three factors $D_1N_2Z_3$ can give better results in wheat growth.

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7. References

1. Annual yield of wheat in India FY 2014-2021, https://www.statista.com/statistics/764310/india-yield-of-wheat/, Mar 16, 2022.
2. Borras–Gelonch G, Rebetzke GJ, Richards RA, Romagosa I. Genetic control of duration of pre-anthesis phases in wheat (*Triticum aestivum* L.) and relationships to leaf appearance, tillering, and dry matter accumulation. J Exp. Bot. 2012;63(1):69-89.
3. Dreccer MF, Chapman SC, Rattey AR, Neal J, Song Y, Christopher JT, *et al*. Developmental and growth controls of tillering and water–soluble carbo-hydrate accumulation in contrasting wheat (*Triticum aestivum* L.) genotypes: Can we dissect them? J Exp. Bot. 2013;64(1):143-160.
4. Mengel K, Kirkby E. A. Principles of Plant Nutrition, edn 4, Panina Publishing Corporation, New Delhi; c1996. p. 147-9.
5. Indira Chaturvedi. Effects of different nitrogen levels on growth, yield and nutrient uptake of wheat (*Triticum aestivum* L.), Internat. J agric. Sci. 2006;2(2):372-374.
6. Graham C. Split Application of Nitrogen in Winter Wheat, https://extension.sdstate.edu/about/our-experts/christopher-graham, August 26, 2020.
7. Wang JW, Mao H, Zhao HB. Different increases in maize and wheat grain zinc concentrations caused by soil and foliar applications of zinc in loess plateau, China. Field Crops Res. 2012;135:89–96.
8. Li M, Wang S, Tian X, Zhao J, Li H, Guo C, *et al*. Zn distribution and bioavailability in whole grain and grain fractions of winter wheat as affected by applications of soil N and foliar Zn combined with N or P. Journal of Cereal Science. 2015;61:26-32.
9. Zadoks JC, Chang TT, Konzak CF. A decimal code for the growth stages of cereals. Weed Res. 1974;14(6):415-421.
10. Sattar A, Cheema MA, Farooq M, Wahid MA, Wahid A, Babar BH. Evaluating the performance of wheat varieties under late sown conditions. Int. J Agric. Biol. 2010;12:561-565.
11. Warrington IJ, Kanemasu ET. Corn growth response to temperature and photoperiod II. Leaf initiation and leaf-appearance rates, Agron. J. 1983;75(5):755 761.
12. Imtiaz M. Zinc Nutrition of Wheat: I: Growth and Zinc Uptake M. Imtiaz, BJ Alloway, KH Shah, SH Siddiqui, MY Memon, M. Aslam and P. Khan. Asian Journal of Plant Sciences. 2003;2(2):152-155.
13. Zinc Fact Sheet: wheat, https://crops.zinc.org/wp-content/uploads/sites/11/2016/12/pdf_WheatFactSheet-May2013.pdf, May; c2013.
14. Bettger WJ, Odell BL. A critical physiological role of zinc in the structure and function of bio-membranes, Life Sciences. 1981;28(13):1425-1438.