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Madhukar Singh
Research Scholar, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

OP Singh
Assistant Professor, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Subhash Kumar
Research Scholar, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

DK Tripathi
Assistant Professor, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Sanjay Kumar Tripathi
Research Scholar, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Janki Prasad
Research Scholar, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Madhukar Singh
Research Scholar, Department of Crop Physiology, C. S. Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

To study the effect of foliar application of Zn and Fe on growth, development and yield of wheat variety under normal and late sown condition

Madhukar Singh, OP Singh, Subhash Kumar, DK Tripathi, Sanjay Kumar Tripathi and Janki Prasad

Abstract
The field experiments were conducted at Student's Instructional Farm, of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (U.P.) India, during Rabi seasons *i.e.* 2017-18 and 2018-19. The objectives of investigation were to "Studies of foliar application with zinc and iron on growth, yield and quality of Wheat (*Triticum aestivum* L.) Under normal and late sown conditions". It was designed in split plot design with three replications. The two date of sowing *i.e.* timely (D_1) and late sown (D_2) conditions were allocated in the main plots and in sub plot that significantly higher yield (kg/ha), (4951 and 5110) significant higher with normal sown condition with both years, Foliar spray application of zinc 200 ppm showed significantly better response both years *i.e.* (4852 and 5008) and iron level 200 ppm given statistically best response *i.e.* (4823 and 4978) compare to control. The same results were recorded with morphological traits, physiological traits, phonological traits and biochemical traits.

Keywords: Morphological traits, physiological traits, replications, significantly, student's instructional farm

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important cereal crops of the word. The importance of Wheat at global level can be realized from the fact that the FAO symbol is a breaded wheat spike with the Latin motto 'Flat pains' meaning 'let there be bread' bread made from wheat has been the stuff of life for millions of millions human being, right from the dawn of civilization when man first turned from arboreal or nomadic life to settled agriculture based on cultivation. Wheat is the most widely cultivated crop, which provides food and nutrition to two-third population of the world. India ranks second in wheat production in the world next to China.

The total area under the wheat crop is about 29.8 million hectares in the country. Wheat production for is estimated between 98 million to 105 million tonnes, in 2020 growing at an average annual rate of 3.42%. India contributes gross area of 30.4 million hectare with annual production of wheat 92.08 million metric tonnes and productivity is 3.1 tonnes ha^{-1}. Wheat production for Uttar Pradesh was 32.59 million tonnes. Wheat production of Uttar Pradesh increased from 30.06 million tonnes in 2017 to 32.59 million tonnes in 2020 growing at an average annual rate of 2.76%. Micronutrient malnutrition *i.e.* inadequate dietary intake of iron (Fe), zinc (Zn), vitamin A and iodine (the "big four"), threatens more than 2 billion people, predominantly in developing countries (Stein, 2010). They contribute to edible dry matter, and daily calorie intake, up to 28% and 60%, respectively, in developing countries. However, in developing countries, nutrition deficiency is a serious problem associated with poor diet. Food and nutrient intake constitute the basis of life; people are dying en masse due to a lack of sufficient nutrients. As reported by Graham, every second, one person dies of disease related to diet. Moreover, Fe deficiency affects more than two billion individuals, or one in three people globally, while about 30% of people in developing countries and 10% of Americans and Canadians are Zn deficient It is estimated that, of the world's 6 billion people, 60-80% are Fe deficient, more than 30% are Zn deficient, 30% are iodine (I) deficient and about 15% are selenium (Se) deficient. Among the micro nutrients, Zn and Fe deficiencies are occurring in both crops and human.

Location and Climatic Conditions

All facilities related to study were available at the Experimental Research Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. Geographically Kanpur is located at 26.30° North Longitude and 80.16° East Longitude and is above 127 meters at above sea level. It lies in the sub-tropical regions where Wheat is grown in Rabi seasons. During experimentations, temperature was cool during vegetative growth while it was cool during grain filling stages in both years of experimentations. Weather conditions prevailing during study are presented in Table No. 1. which was noted from Department of Meteorology, C.S. Azad University of Agriculture and Technology Kanpur.

Material and Experimental technique

Treatments and design

Table 1: The following treatments are to be applied in Rabi sown variety of wheat (*Triticum aestivum* L.) K-307

Location	:	Student Instructional Farm Kanpur
Statistical Design	:	Split Plot Design Main plot: Date of sowing (D) Sub plot: Treatment (T)
Replication	:	Three (3)
Area	:	42×25 =1050 m^2
Single Plot Size	:	4×3 m^2
Total No. of Plots	:	54
Date of Sowing	:	2
Variety	:	(K-307) Shatabdi
Plant to Plant Distance	:	20
Row to Row Distance	:	15

Main plot treatment (02)

D_1: Normal sown condition: Last week of November

D_2: Late sown condition: First week of December

Sub plot (Zn) 03		Sub plot (Fe) 03	Date of sowing (02)
0 ppm Zn_0		0 ppm Fe_0	D_1
200 ppm Zn_1	×	200 ppm Fe_1	×
400 ppm Zn_2		400 ppm Fe_2	D_2

Table 2: Treatment Combinations: Total combination of treatment will be 18 these are below following-

S. No.	Treatment combinations	S. No.	Treatment combinations
1.	T_1 D_1 Zn_0 Fe_0	10.	T_{10} D_2 Zn_0 Fe_0
2.	T_2 D_1 Zn_0 Fe_1	11.	T_{11} D_2 Zn_0 Fe_1
3.	T_3 D_1 Zn_0 Fe_2	12.	T_{12} D_2 Zn_0 Fe_2
4.	T_4 D_1 Zn_1 Fe_0	13.	T_{13} D_2 Zn_1 Fe_0
5.	T_5 D_1 Zn_1 Fe_1	14.	T_{14} D_1Zn_1 Fe_1
6.	T_6 D_1 Zn_1 Fe_2	15.	T_{15} D_2 Zn_1 Fe_2
7.	T_7 D_1 Zn_2 Fe_0	16.	T_{16} D_2 Zn_2 Fe_0
8.	T_8 D_1 Zn_2 Fe_1	17.	T_{17} D_2 Zn_2 Fe_1
9.	T_9 D_1 Zn_2Fe_2	18.	T_{18} D_2 Zn_2 Fe_2

Stages of foliar application of zinc and iron

1. Tillering stages
2. Booting stages

Source of seed material

The seeds of Wheat variety K-307 were obtained from department of seed science of the CSA University of agriculture & technology Kanpur during each year of experimentation.

Field Operation

1. **Application of Fertilizers:** A total dose of 150 kg/ha Nitrogen, 80 kg/ha phosphorus and 60 kg/ha potash, through urea, single super phosphate (SSP) and murate of potash (MOP) were used in the experiment. Half dose of nitrogen, total phosphorus and potash were given as basal dose before sowing of seed; remaining half dose of nitrogen was given in two equal split doses, one at tillering and other at the time of spike initiation.
2. **Seed Material and Seed Rate:** The seeds of Wheat variety K-307 were obtained from department of seed science of Csa University of agriculture & technology Kanpur during each year of experimentation. Seed require for timely 100-110 kg ha^{-1} and late sown condition 120-125 kg ha^{-1}.
3. **Method of sowing and weeding:** Sowing was done at 15 cm row spacing by drill method behind the deshi plough in furrows at 3-4 cm depth. Plant to plant distance was maintained 20 cm.
4. **Inter culture:** For better growth and utilization of different fertilizers and nutrients by the plant, field was kept free from all kinds of weed during experimentation. Two weeding were done one at 30 days after sowing and second at 60 days after sowing.
5. **Irrigation:** First irrigation at crown root initiation (CRI), second irrigation at tillering, third irrigation at booting stage and fourth irrigation at milking stage, so total number of four irrigation were done in field during crop season.

Observations recorded

(i). Plant height (cm)

Plant height was measured in centimetres from base of the plant (soil level) to the auricle of the top leaf of the main shoot in early stage of the growth and up to base of the panicle after ear emergence. Measurement was done on the plants which were initially tagged for this purpose and average height (cm) was collected from the data.

(ii). Numbers of Leaves $plant^{-1}$

Number of leaves $plant^{-1}$ under each treatment was recorded by visual counting at the appropriate stage. The plants already tagged for this purpose was used and average leaves $plant^{-1}$ were counting at different stages.

(viii). Dry matter production $plant^{-1}$

The selected three plants were separated into stem, panicle and leaves were sundried. The samples were then oven dried at 70-80°Cfor 8-10 hours. After drying samples were weighted by electronic balance.

(iii). Specific Leaf Weight (SLW) mg/cm^{-2}

The reversal of SLA is called as SLW. It is defined as the ratio between total leaf dry weight in g and leaf area in cm^2.It indicates the relative thickness of the leaf of different genotypes. It was calculated by the following given formula [Pearce *et al.* (1968)].

$$SLW = \frac{WL}{A}$$

(iv). Leaf Area cm^2 plant^{-1}

Leaf area of the plant was measured by following formulae:
Leaf area= L*W*0.65 (Amal *et al.*, 2012)

Where,
L: Length of leaf W: Width of leaf

(v). Leaf area index (LAI)

Leaf area index may be defined as the area of leaves (one side only) divided by the ground area over which is growing. Since, leaf area and land area both have the same unit so leaf area index (LAI) is dimensionless. It has been calculated by the following formula given below:

$$LAI = \frac{\text{Leaf area plant}^{-1}(\text{cm}^{-2}) \times \text{Number of plants m}^{-2}}{\text{Ground area}}$$

(x). Grain Yield (kg/ha)

Produce of net plots was sun dried and threshed grains thus obtained were winnowed, cleaned and weighed. The yield recorded in kg per plot was standardized to 14% moisture and then weight was converted into kg/ha.

Result and Discussion

Plant height (cm) at 90 DAS

The data presented in Table 3 revealed that plant height at 90 days after sowing influenced by foliar application of Zinc and iron at normal and late sown condition-

1. **Effect of sowing date:** The mean value of plant height was significantly influenced by sowing date in both years timely sowing date D_1 *i.e.* 86.31 and 88.84 cm recorded significantly maximum plant height (cm) during 2017-18 and 2018-19 respectively showed best response.
2. **Effect of zinc level:** The effect of zinc level was found to be significant maximum Zn_2 *i.e.* 86.19 cm and 89.06 cm over control in both years.
3. **Effect of Iron level:** Among iron level to plant height at 90 DAS were found to be significant Fe_2 84.48 cm followed by Fe_1 84.12 cm in 2017-18 and Fe_2 86.92 cm followed by Fe_1 86.41 cm over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level-** It is proved that interaction effect between sowing date and zinc level to plant height (cm) evolved was non-significant both years however in combination D_1Zn_2 D_2Fe_0 *i.e.* 89.34 cm and D_1Zn_1 87.72 cm in 2017-18 and D_1Zn_2 D_2Fe_0 *i.e.* 92.35 cm and D_1Zn_1 89.98 cm in year 2018-19 while lowest combination D_2Zn_0 was found to be during both experimental years.
5. **Interaction effect of sowing date and Iron level:** Interaction effect of sowing date and iron level combination was D_1Fe_2 *i.e.* 87.57 cm and 89.85 cm highest in both years and lowest combination found to be D_2Fe_0 in both years respectively to plant height at 90 DAS.
6. **Interaction effect between zinc level and iron level:** It is visualized that the value of both experimental plant height (cm) at 90 DAS noted non significant but numerically maximum value of plant height (cm) measured in combination Zn_2Fe_2 *i.e.* 87.66 and 90.70 cm both years as compared to other combination as minimum in combination Zn_0Fe_0 76.40 and 78.27 cm both concerning years respectively.
7. **Interaction effect among of sowing date, Zinc level and Iron level:**The value of interaction effect among sowing date, zinc level and iron level to plant height (cm) at 90 DAS was obtained maximum from combination $D_1Zn_2Fe_2$ *ie.* 90.86 and 94.15 cm while minimum in combination $D_2Zn_0Fe_0$ *ie.* 73.77 and 73.90 cm with both years of experimentation.

Plant height (cm) at 120 DAS

The data presented in Table 4 revealed that plant height at 120 days after sowing influenced by foliar application of Zinc and iron at normal and late sown condition-

1. **Effect of sowing date:** The mean value of plant height at 120 DAS was significantly influenced by sowing date in both years timely sowing date D_1 *i.e.* 90.11 and 93.96 cm recorded significantly maximum plant height (cm) during 2017-18 and 2018-19 years respectively.
2. **Effect of zinc level:** The mean of zinc level to plant height at 120 DAS was found to be maximum Zn_2 *i.e.* 90.09 cm and 94.08 cm over control in both years showing statistically best response followed by Zn_1 *i.e.* 88.45 and 91.95 cm during both years.
3. **Effect of Iron level:** Among iron level to plant height at 120 DAS were found to be significant Fe_2 D_2Fe_0 *i.e.* 88.07 cm followed by Fe_1 87.91 cm in 2017-18 and Fe_2 D_2Fe_0 *i.e.* 92.11 cm followed by Fe_1 91.74 cm over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level:** It is proved that interaction effect between sowing date and zinc level to plant height at 120 DAS evolved was non-significant both years however in combination D_1Zn_2 D_2Fe_0 *i.e.* 93.40 cm followed by D_1Zn_1 91.68 cm in 2017-18 and D_1Zn_2 D_2Fe_0 *i.e.* 97.46 cm followed by D_1Zn_1 94.85 cm in year 2018-19 while lowest combination D_2Zn_0 was found to be in both years.
5. **Interaction effect of sowing date and Iron level:** Interaction effect combination was D_1Fe_2 D_2Fe_0 *i.e.* 91.08 cm and 95.32 cm highest in both years and lowest combination found to be D_2Fe_0 in both years respectively to plant height 120 DAS.
6. **Interaction effect between zinc level and iron level:** It is visualized that the value of both experimental years plant height to 120 DAS noted non significant but numerically maximum value of plant height (cm) measured in combination Zn_2Fe_2 *i.e.* 91.61 and 95.74 cm both years as compared to other combination as minimum in combination Zn_0Fe_0 *i.e.* 80.02 and 83.63 cm both concerning years respectively.
7. **Interaction effect among of sowing date, Zinc level and Iron level:** The value of interaction effect among sowing date, zinc level and iron level to plant height at 120 DAS was obtained maximum from combination $D_1Zn_2Fe_2$ *i.e.* 94.96 and 99.24 cm while minimum in combination $D_2Zn_0Fe_0$ *i.e.* 77.10 and 80.58 cm with both years of experimentation.

Table 3: Plant height (cm) of wheat at 90 DAS after sowing as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Plant height (cm) at 90 DAS					
	2017-18			2018-19		
	D_1	D_2	Mean	D_1	D_2	Mean
Zn_0 Fe_0	79.03	73.77	76.40	82.65	73.90	78.27
Zn_0 Fe_1	82.67	76.84	79.75	84.82	78.05	81.43
Zn_0 Fe_2	83.96	78.04	81.00	85.15	80.65	82.87
Zn_1 Fe_0	86.59	80.48	83.53	88.85	82.65	85.75
Zn_1 Fe_1	88.68	82.43	85.55	90.85	84.69	87.77
Zn_1 Fe_2	87.91	81.71	84.81	90.25	84.10	87.17
Zn_2 Fe_0	86.90	80.79	83.84	89.15	83.75	86.45
Zn_2 Fe_1	90.26	83.89	87.07	93.75	86.33	90.04
Zn_2 Fe_2	90.86	84.46	87.66	94.15	87.25	90.70
Mean	86.31	80.26	83.29	88.84	82.37	85.60
Treat.	D_1	D_2	Mean	D_1	D_2	Mean
Zn_0	81.88	76.21	79.04	84.20	77.53	80.86
Zn_1	87.72	81.54	84.63	89.98	83.81	86.89
Zn_2	89.34	83.04	86.19	92.35	85.77	89.06
Mean	86.31	80.26	83.29	88.84	82.37	85.60
Treat.	D_1	D_2	Mean	D_1	D_2	Mean
Fe_0	84.17	78.34	81.25	86.88	80.10	83.49
Fe_1	87.20	81.05	84.12	89.80	83.02	86.41
Fe_2	87.57	81.40	84.48	89.85	84.00	86.92
Mean	86.31	80.26	83.29	88.84	82.37	85.60

Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	76.40	79.75	81.00	81.83	78.27	81.43	82.87	83.93
Zn_1	83.53	85.55	84.81	83.55	85.75	87.77	87.17	85.97
Zn_2	83.84	87.07	87.66	84.49	86.45	90.04	90.70	86.92
Mean	81.25	84.12	84.49	83.29	83.49	86.41	86.91	85.60

Factors	SE (diff.)	CD at 5%	SE (diff.)	CD at 5%
D	0.79	3.35	1.00	4.30
Zn	0.82	1.89	1.03	2.37
Fe	0.96	1.99	1.09	2.27
D x Zn	1.16	N.S.	1.45	N.S.
D x Fe	1.36	N.S.	1.55	N.S.
Zn x Fe	1.67	N.S.	1.90	N.S.
D x Zn x Fe	2.36	N.S.	2.69	N.S.

Number of leaves 90 DAS

The data showed on the effect of foliar application of zinc and iron on sowing date and their interaction effect to number of leaves at 90 DAS in Table 5.

1. **Effect of sowing dates:** The mean value of sowing date to number of leaves was recorded statistically significantly maximum in timely sowing date D_1 *i.e.* 39.58 & 41.16 at 90 DAS, minimum in late sowing date D_2 *i.e.* 36.75 & 38.24 for both concerning years 2017-18 and 2018-19.
2. **Effect of zinc level:** The mean value of zinc level was observed significantly higher to number of leaves at 90 DAS for both years Zn_2 *i.e.* 39.60 & 41.30 over control during both years showing statistically significant response with Zn_1 *i.e.* 38.78 & 40.31 during 2017-18 and 2018-19.
3. **Effect of iron level:** The statistically maximum mean value of iron level on number of leaves at 90 DAS was measured significant Fe_2 *i.e.* 38.78 and Fe_1 *i.e.* 38.57 in under lined by same bar 2017-18 and Fe_2 *i.e.* 40.38 and by Fe_1 *i.e.* 40.07 over control in year 2018-19.
4. **Interaction effect between sowing date and zinc level:** In the first year of experimentation the mean value of interaction effect of sowing date and zinc level did not show significant effect on number of leaves at 90 DAS but numerically higher interaction value was found in combination D_1Zn_2 *i.e.* 41.13 D_1Zn_1 40.21 in 2017-18 and D_1Zn_2 *i.e.* 42.91 and D_1Zn_1 41.75 in year 2018-19 while lowest combination D_2Zn_0 was found to be during both years.
5. **Interaction effect between sowing date and iron level**: It is evolved that interaction effect of sowing date and iron level show non-significant effect on number of leaves at both stage but numerically higher interaction value was found in combination D_1Fe_2 *i.e.* 40.20 followed by D_1Fe_1 40.02 in 2017-18 and D_1Fe_2 41.84 followed by D_1Fe_1 41.62 in year 2018-19 while lowest combination D_2Fe_0 was found to be during both years.
6. **Interaction effect between zinc level and iron level**: It is visualized from interaction effect of zinc level and iron level showed non-significant effect on number of leaves at 90 DAS but numerically higher interaction value was found in combination Zn_2Fe_2 *i.e.* 40.42 followed by Zn_2Fe_1 40.03 in 2017-18 and Zn_2Fe_2 42.12 followed by Zn_2Fe_1 41.67 in year 2018-19 while lowest combination Zn_0Fe_0 was found to be during both years.
7. **Interaction effect between sowing dates, zinc level and iron level**: The data on interaction effect of sowing dates, zinc level and iron level to number of leaves did not indicate significant effect and maximum interaction value noted from combination $D_1Zn_2Fe_2$ *i.e.* 41.97 and 43.80 during 2017-18 and 2018-19 respectively While

minimum value of interaction effect to number of leaves observed from combination $D_2Zn_0Fe_0$ *i.e.* 33.65 and 34.85 with both years of experimentation.

Table 4: Number of leaves per plant at 90 days after sowing as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Number of leaves per plant at 90 DAS							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	36.19	33.65		34.92	37.47	34.85		36.16
Zn_0 Fe_1	37.71	35.11		36.41	39.17	36.40		37.78
Zn_0 Fe_2	38.35	35.75		37.05	39.85	37.20		38.52
Zn_1 Fe_0	39.56	36.79		38.17	41.03	38.25		39.64
Zn_1 Fe_1	40.79	37.80		39.29	42.36	39.21		40.78
Zn_1 Fe_2	40.29	37.47		38.88	41.87	39.15		40.51
Zn_2 Fe_0	39.84	36.90		38.37	41.59	38.66		40.12
Zn_2 Fe_1	41.58	38.49		40.03	43.35	39.99		41.67
Zn_2 Fe_2	41.97	38.87		40.42	43.80	40.45		42.12
Mean	39.58	36.75		38.16	41.16	38.24		39.70
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	37.41	34.83		36.12	38.83	36.15		37.49
Zn_1	40.21	37.35		38.78	41.75	38.87		40.31
Zn_2	41.13	38.08		39.60	42.91	39.70		41.30
Mean	39.58	36.75		38.16	41.16	38.24		39.70
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	38.53	35.78		37.15	40.03	37.25		38.64
Fe_1	40.02	37.13		38.57	41.62	38.53		40.07
Fe_2	40.20	37.36		38.78	41.84	38.93		40.38
Mean	39.58	36.75		38.16	41.16	38.24		39.70
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	34.92	36.41	37.05	37.47	36.16	37.78	38.52	38.86
Zn_1	38.17	39.29	38.88	38.27	39.64	40.78	40.51	39.86
Zn_2	38.37	40.03	40.42	38.78	40.12	41.67	42.12	40.38
Mean	37.15	38.57	38.78	38.16	38.64	40.07	40.38	39.70
Factors	SE (diff.)		CD at 5%		SE (diff.)		CD at 5%	
D	0.35		1.50		0.40		1.73	
Zn	0.39		0.91		0.46		1.08	
Fe	0.40		0.84		0.47		0.98	
D x Zn	0.56		N.S.		0.66		N.S.	
D x Fe	0.56		N.S.		0.67		N.S.	
Zn x Fe	0.70		N.S.		0.82		N.S.	
D x Zn x Fe	1.00		N.S.		1.16		N.S.	

Specific Leaf weight (mg cm^{-2}) at 90 DAS

The data regarding on specific leaf weight at 90 DAS as affected due to sowing dates influenced by foliar application of zinc and iron under normal and late sown condition and their interactions effect are predicated in table No. 5

1. **Effect of sowing date:** The statistically maximum value of sowing date to SLW in both years at 90 DAS in timely sowing dates D_1 *i.e.* 6.85 and 6.59 mg cm^{-2} recorded significantly maximum during 2017-18 and 2018-19 and minimum value recorded over late sowing date D_2 *i.e.* 5.81 and 5.52 mg cm^{-2} at 90 DAS during both years experimental respectively.
2. **Effect of zinc level:** The effect of zinc level was found to be maximum Zn_2 *i.e.* 6.63 and 6.39 over control in both years showing statistically significantly same response with Zn_1 *i.e.* 6.43 and 6.10 respectively 2017-18 and 2018-19.
3. **Effect of iron level:** The significant effect of treatment was noted on SLW in mg cm^{-2} for both years. The statistically higher mean value of SLW (mg cm^{-2}) observed in treatment to be significant Fe_2 6.46 followed by 6.38 in 2017-18 and Fe_2 6.19 followed by Fe_1 6.13 over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level-** It is revealed that interaction effect of sowing date with zinc level was non- significant at 60 DAS for both years. However in combination D_1Zn_2 *i.e.* 7.11 followed by D_1Zn_1 6.92 in 2017-18 and D_1Zn_2 6.85 followed by D_1Zn_1 6.65 in year 2018-19 while lowest combination D_2Zn_0 was found to be during both years.
5. **Interaction effect of sowing dates and iron level:** Interaction effect of sowing date and iron level to SLW at 90 DAS combination was D_1Fe_2 *i.e.* 6.94 and 6.66 highest during both years and lowest combination found to be D_2Fe_0 in both years respectively.
6. **Interaction effect of zinc level and iron level:** The value of interaction effect of zinc level and iron level to SLW in mg cm^{-2} did not significant at 90 DAS for both years. However numerically maximum interaction value in combination Zn_2Fe_2 *i.e.* 6.82 and 6.63 mg cm^{-2} while minimum in combination Zn_0Fe_0 *i.e.* 5.83 and 5.58 mg cm^{-2} during years 2017-18 and 2018-19.
7. **Interaction effect among sowing date, zinc level and iron level:** The value of Interaction effect among sowing date, zinc level and iron level to SLW was obtained maximum from combination $D_1Zn_2Fe_2$ *i.e.* 7.24 and 6.99 while minimum in combination $D_2Zn_0Fe_0$ *i.e.* 5.23 and 4.97 with both years of experimentation.

Table 5: Specific leaf weight (mg/cm2) 90 days after sowing of wheat crop as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Specific leaf weight (mg/cm2) at 90 DAS							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	6.44	5.23		5.83	6.19	4.97		5.58
Zn_0 Fe_1	6.52	5.28		5.90	6.31	4.98		5.65
Zn_0 Fe_2	6.60	5.55		6.07	6.32	5.29		5.80
Zn_1 Fe_0	6.62	5.80		6.21	6.36	5.35		5.85
Zn_1 Fe_1	7.15	6.01		6.58	6.92	5.67		6.30
Zn_1 Fe_2	7.00	5.99		6.49	6.68	5.62		6.15
Zn_2 Fe_0	6.90	5.94		6.42	6.60	5.57		6.09
Zn_2 Fe_1	7.19	6.13		6.66	6.94	5.95		6.45
Zn_2 Fe_2	7.24	6.40		6.82	6.99	6.26		6.63
Mean	6.85	5.81		6.33	6.59	5.52		6.05
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	6.52	5.35		5.94	6.27	5.08		5.67
Zn_1	6.92	5.93		6.43	6.65	5.55		6.10
Zn_2	7.11	6.16		6.63	6.85	5.93		6.39
Mean	6.85	5.81		6.33	6.59	5.52		6.05
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	6.66	5.66		6.16	6.38	5.30		5.84
Fe_1	6.95	5.81		6.38	6.72	5.54		6.13
Fe_2	6.94	5.98		6.46	6.66	5.72		6.19
Mean	6.85	5.81		6.33	6.59	5.52		6.05
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	5.83	5.90	6.07	5.94	5.58	5.65	5.80	5.67
Zn_1	6.21	6.58	6.49	6.43	5.85	6.30	6.15	6.10
Zn_2	6.42	6.66	6.82	6.63	6.09	6.45	6.63	6.39
Mean	6.16	6.38	6.46	6.33	5.84	6.13	6.19	6.05
Factors	SE (diff.)			CD at 5%	SE (diff.)			CD at 5%
D	0.08			0.37	0.06			0.28
Zn	0.15			0.36	0.13			0.44
Fe	0.21			0.39	0.17			0.34
D x Zn	0.22			N.S.	0.19			N.S.
D x Fe	0.29			N.S.	0.25			N.S.
Zn x Fe	0.36			N.S.	0.30			N.S.
D x Zn x Fe	0.51			N.S.	0.43			N.S.

Leaf Area per plant at 90 DAS

The data regarding on Leaf Area per plant at 90 DAS as affected due to sowing dates influenced by foliar application of zinc and iron under normal and late sown condition and their interactions effect are predicated in table No. 6.

1. **Effect of sowing date:** The statistically maximum value of sowing date to leaf area per plant at both stages *i.e.* 90 DAS in timely sowing dates D_1 *i.e.* 598.18 cm^2 and 621.86 cm^2 recorded significantly maximum during 2017-18 and 2018-19 and minimum value recorded over late sowing date D_2 *i.e.* 484.67 cm^2 and 516.90 cm^2 at 90 DAS during both years experimental respectively.
2. **Effect of zinc level:** The effect of zinc level to leaf area at 90 DAS was found to be maximum Zn_2 *i.e.* 596.03 cm^2 and 635.72 cm^2 over control in both years sowing statistically showed good response.
3. **Effect of iron level:** The significant effect of treatment was noted on leaf area 90 DAS for both years. The statistically higher mean value of leaf area observed in treatment to be significant *i.e.* Fe_2 565.06 cm^2 followed by 552.50 cm^2 in 2017-18 and Fe_2 *i.e.* 601.98 cm^2 followed by Fe_1 584.80 cm^2 over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level:** It is revealed that interaction effect of sowing date with zinc level was non- significant at 90 DAS for both years. However in combination with zinc level recorded maximum leaf area D_1Zn_2 *i.e.* 662.53 followed by D_1Zn_1 *i.e.* 606.71 cm^2 in 2017-18 and D_1Zn_2 *i.e.* 701.18 cm^2 followed by D_1Zn_1 *i.e.* 642.01 cm^2 in years 2018-19 while lowest combination D_2Zn_0 was found to be in both years.
5. **Interaction effect of sowing dates and iron level:** Interaction effect combination was D_1Fe_2 *i.e.* 619.41 cm^2 and 657.12 cm^2 highest in both years and lowest combination found to be D_2Fe_0 during both years respectively.
6. **Interaction effect of zinc level and iron level:** Although data on interaction effect of zinc level and iron level to leaf area did not significant at 90 DAS for both years. However numerically maximum interaction value in combination Zn_2Fe_2 *i.e.* 639.11 cm^2 and 682.80 cm^2 while minimum in combination Zn_0Fe_0 *i.e.* 411.19 cm^2 and 430.61 cm^2.
7. **Interaction effect among sowing date, zinc level and iron level:** The value of Interaction effect among sowing date, zinc level and iron level to leaf area at 90 DAS was obtained maximum from combination $D_1Zn_2Fe_2$ *i.e.* 715.39 cm^2 and 760.08 cm^2 while minimum in combination $D_2Zn_0Fe_0$ *i.e.* 370.65 cm^2 and 385.21 cm^2 with both years of experimentation.

Table 6: Leaf area per plant 90 DAS as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Leaf area per plant 90 DAS							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	451.73	370.65		411.19	476.01	385.21		430.61
Zn_0 Fe_1	503.95	415.57		459.76	529.20	444.11		486.65
Zn_0 Fe_2	530.24	434.79		482.51	562.02	467.32		514.67
Zn_1 Fe_0	573.20	471.93		522.56	608.45	500.07		554.26
Zn_1 Fe_1	634.34	546.00		590.17	668.33	576.95		622.64
Zn_1 Fe_2	612.60	534.53		573.56	649.26	567.69		608.47
Zn_2 Fe_0	597.76	485.07		541.41	630.93	527.57		579.25
Zn_2 Fe_1	674.45	540.72		607.58	712.54	577.67		645.10
Zn_2 Fe_2	715.39	562.83		639.11	760.08	605.53		682.80
Mean	598.18	484.67		541.42	621.86	516.90		613.69
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	495.30	407.00		451.15	522.41	432.21		477.31
Zn_1	606.71	517.48		562.10	642.01	548.23		595.12
Zn_2	662.53	529.54		596.03	701.18	570.25		635.72
Mean	598.18	484.67		541.42	621.86	516.90		613.69
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	540.89	442.55		491.72	571.79	470.95		521.37
Fe_1	604.24	500.76		552.50	636.69	532.91		584.80
Fe_2	619.41	510.71		565.06	657.12	546.84		601.98
Mean	588.18	484.67		541.42	621.86	516.90		613.69
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	411.19	459.76	482.51	451.15	430.61	486.65	514.67	477.31
Zn_1	522.56	590.17	573.56	562.10	554.26	622.64	608.47	595.12
Zn_2	541.41	607.58	639.11	596.03	579.25	645.10	682.80	635.72
Mean	491.72	552.50	565.06	541.42	521.37	584.80	601.98	613.69

Factors	SE (diff.)	CD at 5%	SE (diff.)	CD at 5%
D	5.03	21.65	6.57	28.29
Zn	8.93	20.60	10.97	25.31
Fe	11.91	24.58	14.70	30.34
D x Zn	12.63	N.S.	15.52	N.S.
D x Fe	16.84	N.S.	20.79	N.S.
Zn x Fe	20.62	N.S.	25.46	N.S.
D x Zn x Fe	29.17	N.S.	36.01	N.S.

Leaf Area Index per plant at 90 DAS

The data regarding on Leaf Area index per plant at 90 DAS as affected due to sowing dates influenced by foliar application of zinc and iron under normal and late sown condition and their interactions effect are predicated in table No. 7.

1. **Effect of sowing date:** The statistically maximum value of sowing date to leaf area index per plant at 90 DAS in timely sowing dates D_1 *i.e.* 5.228 and 5.528 recorded significantly maximum during 2017-18 and 2018-19 and minimum value recorded over late sowing date D_2 *i.e.* 4.308 and 4.595 at 90 DAS during both years of experimentation.
2. **Effect of zinc level:** The effect of zinc level was found to be significant at maximum Zn_2 *i.e.* 5.306 and 5.651 over control in both years showing statistically good response.
3. **Effect of iron level:** The significant effect of treatment was noted on leaf area at 90 DAS for both years. The statistically higher mean value of leaf area index at 90 DAS observed in treatment to be significant Fe_2 *i.e.* 5.023 followed by Fe_1 4.911 in 2017-18 and Fe_2 5.351 followed by Fe_1 5.198 over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level:** It is revealed that interaction effect of sowing date with zinc level was non-significant at 30 DAS for both years. However in combination D_1Zn_2 *i.e.* 5.889 followed by D_1Zn_1 5.393 in 2017-18 and D_1Zn_2 *i.e.* 6.233 followed by D_1Zn_1 5.707 in year 2018-19 while lowest combination D_2Zn_0 was found to be in both years.
5. **Interaction effect of sowing dates and iron level:** Interaction effect combination was recorded D_1Fe_2 *i.e.* 5.506 and 5.841 highest in both years and lowest combination found to be D_2Fe_0 during both years respectively.
6. **Interaction effect of zinc level and iron level:** The data on interaction effect of zinc level and iron level to leaf area index did not significant at 90 DAS for both years. However numerically maximum interaction value in combination Zn_2Fe_2 *i.e.* 5.681 and 6.070 in both years of combination while minimum in combination Zn_0Fe_0 *i.e.* 3.655 and 3.828 in both years of experiments.
7. **Interaction effect among sowing date, zinc level and iron level-** The value of Interaction effect among sowing date, zinc level and iron level to leaf area index at 90 DAS was obtained maximum from combination $D_1Zn_2Fe_2$ *i.e.* 6.359 and 6.757 in both years while minimum in combination $D_2Zn_0Fe_0$ *i.e.* 3.295 and 3.424 with both years of experimentation.

Table 7: Leaf area index per plant at 90 days as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Leaf area index per plant at 90 DAS							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	4.015	3.295		3.655	4.231	3.424		3.828
Zn_0 Fe_1	4.480	3.694		4.087	4.704	3.948		4.326
Zn_0 Fe_2	4.713	3.865		4.289	4.996	4.154		4.575
Zn_1 Fe_0	5.095	4.195		4.645	5.409	4.445		4.927
Zn_1 Fe_1	5.639	4.807		4.223	5.941	5.129		5.535
Zn_1 Fe_2	5.446	4.751		5.099	5.771	5.046		5.409
Zn_2 Fe_0	5.314	4.312		4.813	5.608	4.690		5.149
Zn_2 Fe_1	5.995	4.853		5.424	6.334	5.135		5.735
Zn_2 Fe_2	6.359	5.003		5.681	6.757	5.383		6.070
Mean	5.228	4.308		4.768	5.528	4.595		5.061
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	4.403	3.618		4.010	4.644	3.842		4.243
Zn_1	5.393	4.584		4.989	5.707	4.873		5.290
Zn_2	5.889	4.723		5.306	6.233	5.069		5.651
Mean	5.228	4.308		4.768	5.528	4.595		5.061
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	4.808	3.934		4.371	5.083	4.186		4.634
Fe_1	5.371	4.451		4.911	5.660	4.7037		5.198
Fe_2	5.506	4.540		5.023	5.841	4.861		5.351
Mean	5.228	4.308		4.768	5.528	4.595		5.061
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	3.655	4.087	4.289	4.010	3.828	4.326	4.575	4.243
Zn_1	4.645	5.223	5.099	4.989	4.927	5.535	5.409	5.290
Zn_2	4.813	5.424	5.681	5.306	5.149	5.735	6.070	5.651
Mean	4.371	4.911	5.023	4.768	4.634	5.198	5.351	5.061

Factors	SE (diff.)	CD at 5%	SE (diff.)	CD at 5%
D	0.066	0.284	0.078	0.335
Zn	0.112	0.258	0.130	0.301
Fe	0.149	0.308	0.176	0.364
D x Zn	0.158	N.S.	0.188	N.S.
D x Fe	0.211	N.S.	0.249	N.S.
Zn x Fe	0.258	N.S.	0.305	N.S.
D x Zn x Fe	0.365	N.S.	0.432	N.S.

Total Dry Weight (g) 120 DAS

A perusal of the data presented in Table no. 8 revealed that 120 days to total dry weight after sowing as influenced by foliar application of zinc and iron at normal and late sown

condition-

1. **Effect of sowing date:** It is visualized from the table that the mean value of sowing date of both experimental years statistically influenced the days to total dry weight (g) at 120 DAS. The significantly higher mean value observed in D_1 *i.e.* 20.48 gm and 20.73 gm and lower in D_2 *i.e.* 18.40 and 18.56 to total dry weight in both years at 120 DAS.
2. **Effect of zinc level:** The effect of zinc was found to be maximum Zn_2 *i.e.* 20.89 gm and 21.01 gm over control which showed statistically best response during both the years of experiments.
3. **Effect of iron level:** Among iron level to total dry weight at 120 DAS were found to be significant Fe_2 20.08 gm followed by Fe_1 19.67 gm in 2017-18 and Fe_2 20.21 gm followed by Fe_1 19.96 gm over control in year 2018-19.
4. **Interaction effect of sowing date and zinc level:** It is observed that interaction effect between sowing date and zinc level to total dry weight evolved was non-significant both years however in combination D_1Zn_2 *i.e.* 21.99 gm and D_1Zn_1 20.64 gm in 2017-18 and D_1Zn_2 *i.e.* 21.99 gm and D_1Zn_1 20.85 gm in year 2018-19 while lowest combination D_2Zn_0 was found to be in both years.
5. **Interaction effect of sowing date and iron level:** Interaction effect combination was D_1Fe_2 *i.e.* 21.13 gm and 21.27 gm highest in both years and lowest combination found to be D_2Fe_0 in both years respectively to total dry weight at 120 DAS.
6. **Interaction effect between zinc level and iron level:** It is visualized that the value of both experimental total dry weight noted non significant but numerically maximum value of total dry weight found in combination Zn_2Fe_2 *i.e.* 21.75 gm and 21.85 gm both years as compared to other combination as minimum in combination Zn_0Fe_0 both concerning years respectively.
7. **Interaction effect among of sowing date, zinc level and iron level:** The value of interaction effect among sowing date, zinc level and iron level to total dry weight was obtained maximum from combination $D_1Zn_2Fe_2$ *i.e.* 22.67 gm and 22.75 gm while minimum in combination $D_2Zn_0Fe_2$ *i.e.* 16.63 gm and 16.77 gm with both years of experimentation.

Table 8: Total dry weight (gm) 120 DAS as influenced by foliar application of Zinc and Iron at normal and late sown condition

Treatments	Total dry weight (gm) 120 DAS							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	18.17	16.63		17.40	18.41	16.77		17.59
Zn_0 Fe_1	18.67	16.96		17.81	19.78	17.11		18.44
Zn_0 Fe_2	19.61	17.35		18.48	19.88	17.50		18.69
Zn_1 Fe_0	19.63	17.39		18.51	19.99	17.56		18.77
Zn_1 Fe_1	21.19	18.95		20.07	21.37	19.03		20.20
Zn_1 Fe_2	21.11	18.91		20.01	21.19	19.00		20.09
Zn_2 Fe_0	20.91	18.69		19.80	21.02	18.82		19.92
Zn_2 Fe_1	22.39	19.87		21.13	22.20	20.33		21.26
Zn_2 Fe_2	22.67	20.84		21.75	22.75	20.96		21.85
Mean	20.48	18.40		19.44	20.73	18.56		19.64
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	18.81	16.98		17.89	19.35	17.12		18.23
Zn_1	20.64	18.41		19.52	20.85	18.53		19.69
Zn_2	21.99	19.80		20.89	21.99	20.03		21.01
Mean	20.48	18.40		19.44	20.73	18.56		19.64
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	19.57	17.57		18.57	19.80	17.71		18.75
Fe_1	20.75	18.59		19.67	21.11	18.82		19.96
Fe_2	21.13	19.03		20.08	21.27	19.15		20.21
Mean	20.48	18.40		19.44	20.73	18.56		19.64
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	17.40	17.81	18.48	17.90	17.59	18.44	18.69	18.24
Zn_1	18.51	20.07	20.01	19.53	18.77	20.20	20.09	19.68
Zn_2	19.80	21.13	21.75	20.89	19.92	21.26	21.85	21.01
Mean	18.57	19.67	20.08	19.44	18.76	19.96	20.21	19.64
Factors	SE (diff.)		CD at 5%		SE (diff.)		CD at 5%	
D	0.30		1.31		0.37		1.61	
Zn	0.41		0.94		0.49		1.14	
Fe	0.41		0.84		0.48		0.99	
D x Zn	0.58		N.S.		0.70		N.S.	
D x Fe	0.58		N.S.		0.68		N.S.	
Zn x Fe	0.71		N.S.		0.83		N.S.	
D x Zn x Fe	1.00		N.S.		1.18		N.S.	

Grain yield (kg/ha)

The presented in Table no. 9 data revealed that grain yield (kg/ha) as influenced by foliar application of zinc and iron at normal and late sown condition.

1. **Effect of sowing date:** The mean value of grain yield for sowing date evolved that normal sowing date D_1 statistically significant increased grain yield (kg/ha) of wheat *i.e.* 4951 and 5110 over normal and late sowing date D_2 *i.e.* 4602 and 4750 during the year 2017-18 and 2018-19 respectively hence normal sowing date

statistically given best response over late sown condition.

2. **Effect of zinc level:** The mean value of grain yield (kg/ha) to zinc level was statistically influenced by zinc 400 ppm showed maximum *i.e.* 4941 and 5100 during both experimental year followed by zinc level 200 ppm during 2017-18 and 2018-19.
3. **Effect of iron level:** The mean value of grain yield (kg/ha) statistically influenced by iron level in both years among the iron level 400 ppm and 200 ppm statistically showed same response *i.e.* 4844 and 4823 in 2017-18 and during year 2018-19 *i.e.* 5000 and 4978 respectively.
4. **Interaction effect of date of sowing and zinc level:** It is observed that D_1Zn_2 combination showing highest grain yield (kg/ha)) *i.e.* 5122 and minimum D_2Zn_0 4370 in 2017-18 and 2018-19 *i.e.* 5287 and 4510 respectively.
5. **Interaction effect of date of sowing and iron level:** During first year and second year interaction effect showed non-significant effect but maximum combination of grain yield (kg/ha) was found to be D_1Fe_2 *i.e.* 5022 and 5183 during both years and minimum value D_2Fe_0 *i.e.* 4492 and 4636 both experimental years.
6. **Interaction effect of zinc level and iron level:** The interaction effect of zinc level and iron level on grain yield (kg/ha) more value of the combination Zn_2Fe_2 *i.e.* 5026 and 5187 during both years and minimum value was recorded in control Zn_0Fe_0 *i.e.* 4390 and 4531 respectively.
7. **Interaction effect of sowing date, zinc level and iron level:** The interaction effect of sowing date, zinc level and iron level was found to be non significant but numerically more value of the combination $D_1Zn_2Fe_2$ *i.e.* 5210 and 5377 followed by $D_1Zn_2Fe_1$ *i.e.* 5175 and 5341 and least in combination $D_2Zn_0Fe_0$ *i.e.* 4230 and 4366 for both corresponding years of experimentation.

Table 9: Grain Yield (Kg/ha) as influenced by foliar application of zinc and iron at normal and late sown condition

Treatments	Grain yield (kg/ha)							
	2017-18				2018-19			
	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0 Fe_0	4551	4230		4390	4697	4366		4531
Zn_0 Fe_1	4740	4406		4573	4892	4547		4719
Zn_0 Fe_2	4815	4475		4645	4969	4619		4794
Zn_1 Fe_0	4965	4615		4790	5124	4763		4943
Zn_1 Fe_1	5085	4726		4905	5248	4878		5063
Zn_1 Fe_2	5041	4685		4863	5203	4834		5018
Zn_2 Fe_0	4983	4632		4807	5143	4781		4962
Zn_2 Fe_1	5175	4810		4992	5341	4964		5152
Zn_2 Fe_2	5210	4843		5026	5377	4998		5187
Mean	4951	4602		4776	5110	4750		4930
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Zn_0	4702	4370		4536	4852	4510		4681
Zn_1	5030	4675		4852	5191	4825		5008
Zn_2	5122	4761		4941	5287	4914		5100
Mean	4951	4602		4776	5110	4750		4930
Treat.	D_1	D_2		Mean	D_1	D_2		Mean
Fe_0	4833	4492		4662	4988	4636		4812
Fe_1	5000	4647		4823	5160	4796		4978
Fe_2	5022	4667		4844	5183	4817		5000
Mean	4951	4602		4776	5110	4750		4930
Treat.	Fe_0	Fe_1	Fe_2	Mean	Fe_0	Fe_1	Fe_2	Mean
Zn_0	4390	4573	4645	4536	4531	4719	4794	4681
Zn_1	4790	4905	4863	4852	4943	5063	5018	5008
Zn_2	4807	4992	5026	4941	4962	5152	5187	5100
Mean	4662	4823	4844	4776	4812	4978	4999	4930
Factors	SE (diff.)		CD at 5%		SE (diff.)		CD at 5%	
D	39.96		171.97		49.26		211.96	
Zn	54.20		124.97		55.88		128.87	
Fe	46.49		95.96		53.81		111.06	
D x Zn	76.65		N.S.		79.03		N.S.	
D x Fe	65.75		N.S.		76.10		N.S.	
Zn x Fe	80.53		N.S.		93.20		N.S.	
D x Zn x Fe	113.89		N.S.		131.81		N.S.	

Conclusion

Finally, It may be concluded that significantly higher yield (kg/ha), (4951 and 5110) significant higher with normal sown condition with both years, Foliar spray application of zinc 200 ppm showed significantly better response both years *i.e.* (4852 and 5008) and iron level 200 ppm given statistically best response *i.e.* (4823 and 4978) compare to control. The same results were recorded with morphological traits, physiological traits, phonological traits and biochemical traits. Traits like grain growth rate, number of grain per spike, test weight, harvest index, zinc content in grain, iron content in grain and protein content exhibit same results enhancing to get higher grain yield of wheat and showed significantly higher positive correlation with grain yield during both corresponding years.

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