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Influence of zinc, copper, manganese and boron on biochemical parameters and yield in wheat (*Triticum aestivum* L.)

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Abstract
A field experiment was conducted during *Rabi* 2022, to study the influence of zinc, copper, manganese and boron on wheat. The experiments was laid down in randomized block design with twelve treatments and three replications at research farm of Botany Section College of Agriculture, Nagpur. The aim of this work was to study the effect of foliar application of zinc, copper, manganese and boron at T_1 (control), T_2 (1% $CuSO_4$), T_3 (1% $ZnSO_4$), T_4 (1% $MnSO_4$), T_5 (1% Boron), T_6 (1% $CuSO_4$ +1% $ZnSO_4$), T_7 (1% $CuSO_4$ +1% $MnSO_4$), T_8 (1% $CuSO_4$ +1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_{10} (1% $ZnSO_4$ + 1% Boron, T_{11} (1% $MnSO_4$ +1% Boron) and T_{12} (1% $CuSO_4$ +1% $ZnSO_4$ +1% $MnSO_4$ +1% Boron) on biochemical parameters and yield in wheat. Spraying of zinc, copper, manganese and boron was done two times *i.e*., on 25 and 40 DAS. Observations about biochemical parameters like leaf chlorophyll, nitrogen content in leaves and protein content in seed were also estimated. Observation on yield contributing parameters like number of spikelets ear^{-1}, spike length, number of grain ears^{-1}, grain weight ear^{-1}, 1000 grain weight, seed yield plant^{-1} (g), plot^{-1} (kg) and ha^{-1} (q), harvest index recorded. Foliar sprays of 1% $CuSO_4$ +1% $ZnSO_4$ +1% $MnSO_4$ + 1% Boron followed by 1% $ZnSO_4$ + 1% Boron significantly enhanced biochemical parameters and yield contributing parameters when compared with control and rest of the treatments under study.

Keywords: $ZnSO_4$, $MnSO_4$, $CuSO_4$, Boron, foliar spray, biochemical parameters and yield

Introduction
Wheat is a self-pollinated crop originated from south-western Asia, is considered as the second most important cereal crop in the world after rice. It has been described as the 'King of cereals' because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It belongs to genus '*Triticum*' of poaceae (Gramineae) family and there are 17 different species. Most of the cultivated wheat varieties belongs to three main species of the genus *Triticum*. These are the hexaploid, *T. aestivum* L. (bread wheat), the tetraploid, *T. durum* and the diploid, *T. dicocum*. Globally, *T. aestivum* wheat is the most important species which covers 95 percent of the area. Second popular wheat being durum wheat which covers about 4 percent while, *T. dicoccum* wheat cover less than one percent of the total area.

Wheat is one of the most essential foods in the world. To increase its productivity, nutrient management is one of the most important factors. In wheat production, micronutrients play a vital role in the yield improvement.

Materials and Methods
The project entitled "Influence of zinc, copper, manganese and boron on morpho-physiological parameters and yield in wheat (*Triticum aestivum* L.)" was carried out during *Rabi* 2022-23 in the field area of section of Agricultural Botany, College of Agriculture, Nagpur in a Randomized Block Design with twelve treatments and three replications. Treatments consists T_1 (control), T_2 (1% $CuSO_4$), T_3 (1% $ZnSO_4$), T_4 (1% $MnSO_4$), T_5 (1% Boron), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ +1% $MnSO_4$), T_8 (1% $CuSO_4$ +1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_{10} (1% $ZnSO_4$ + 1% Boron, T_{11} (1% $MnSO_4$ +1% Boron) and T_{12} (1% $CuSO_4$ +1% $ZnSO_4$ +1% $MnSO_4$ +1% Boron) were tested. The gross plot size 2 m x 2.5 m and net plot size was 1.8 m x 2.3 m with spacing line sowing at 20 cm.

Five plants from each plot were selected randomly and data were collected at 30, 50 and 70 DAS on total chlorophyll content, nitrogen content in leaves and protein content in seeds were calculated 70 DAS. Total chlorophyll content of oven dried leaves was estimated by colorimetric method as suggested by Bruinsma (1982) [1]. Nitrogen content in leaves was estimated by micro Kjeldahl's method as given by Somichi *et al*., 1972 [9]. Protein content in seed plant^{-1}, number of spikelets ear^{-1}, spike length, number of grain ears^{-1}, grain weight ear^{-1}, 1000 grain weight, seed yield plant^{-1}(g), plot^{-1}(kg) and ha^{-1}(q), harvest index and B:C ratio were calculated after harvest. Data was estimated by to statastical analysis as per method suggested by Panse and Sukhatme (1958) [6].

Results and Discussion

Chlorophyll content

At this stage 30 DAS total chlorophyll content in leaves ranged between 1.24 – 1.46 mg g^{-1}. Significantly highest chlorophyll content was observed in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% CuSO4 + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in total chlorophyll content in leaves at compare to control (T1).

At this stage 50 DAS total chlorophyll content in leaves ranged between 1.37 – 1.61 mg g^{-1}. Significantly highest chlorophyll content was observed in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% CuSO4 + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$) and T_2 (1% $CuSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in total chlorophyll content in leaves at compare to control (T_1).

At this stage 70 DAS total chlorophyll content in leaves ranged between 1.25 – 1.52 mg g^{-1}. Significantly highest chlorophyll content was observed in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$) and T_2 (1% $CuSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in total chlorophyll content in leaves at compare to control (T_1). These results are in conformity with the finding Pise *et al*. (2020) [7] where they found significant effect of foliar application of micronutrient mixture ($ZnSO_4$ 0.5%. $FeSO_4$ 0.5%) on chlorophyll contents of wheat.

These results are also in conformity with the findings of Farhan *et al*. (2021) [2] where they found significant effect of foliar application of different times of boron application on chlorophyll contents of wheat.

Protein content in seeds

Data revealed that significantly higher protein content was observed Treatments considering for evaluation of this study were found significantly superior over control. However, treatment However, treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron), recorded the highest protein content i.e., 11.13%, while control (T_1) (water spray) treatment recorded minimum *i.e*., 9.64%. Data regarding protein content was significantly increased in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% ZnSO4), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_5 (1% Boron) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_2 (1% $CuSO_4$) and T_4 (1% $MnSO_4$) significantly higher in protein content in seed as compare to control (T_1). Similar result where reported by Tahir *et al*. (2021) [10] where they obtained significant effect of Zn, B, Fe, Mn and Cu has the highest protein content in wheat.

Leaf nitrogen content

Scrutiny of the data revealed marked effect of foliar spray of $ZnSO_4$, $MnSO_4$, $CuSO_4$ and boron on the nitrogen content of wheat at 30, 50 and 70 DAS.

At 30 DAS nitrogen content in leaves is differed among the treatments and ranged from 3.90 – 4.75%. The best and significant results were obtained in T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{11} (1% $MnSO_4$ + 1% Boron), T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_5 (1% Boron), T_3 (1% $ZnSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_2 (1% $CuSO_4$) and T_4 (1% $MnSO_4$) significantly higher in nitrogen content in leaves at compare to control (T_1).

At 50 DAS nitrogen content in leaves is differed among the treatments and ranged from 3.01 – 4.29%. The best and significant results were obtained in T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{11} (1% $MnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_5 (1% Boron) and T_3 (1% $ZnSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas, the treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_7 (1% $CuSO_4$ + 1% MnSO4), T_2 (1% $CuSO_4$) and T_4 (1% $MnSO_4$) significantly higher in nitrogen content in leaves at compare to control (T_1).

At 70 DAS nitrogen content in leaves is differed among the treatments and ranged from 2.44-3.41%. The best and significant results were obtained in T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_{11} (1% $MnSO_4$ + 1% Boron), T_8 (1% $CuSO_4$ + 1% Boron), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_5 (1% Boron) and T_3 (1% $ZnSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_2 (1% $CuSO_4$) and T_4 (1% $MnSO_4$) significantly higher in nitrogen content in leaves at compare to control (T_1).

Number of spikelets ear^{-1}

Significantly and highest number of spikelets ear^{-1} was recorded by the application T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in number of spikelets ear^{-1} at compare to control (T_1). These results are also in conformity with the findings of Javed *et al*. (2023) [4] where they obtained significant effect of foliar application of zinc (B_0: 0 g ha^{-1}, B_1: 50 g ha^{-1}, B_2: 60 g ha^{-1} and B_3: 70 g ha^{-1}) on number of spikelets of wheat. These results are also in conformity with the findings of Ijaz *et al*. (2023) [3] where they found significant effect of foliar application of micronutrient mixture (Zn + Fe + Cu + B) on number of spikelets of wheat.

Spike length: Significantly and highest number of spike length was recorded by the application T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron) and T_{11} (1% $MnSO_4$ + 1% Boron) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in spike length at compare to control (T_1). These results are also in conformity with the findings of Javed *et al*. (2023) [4] where they found significant effect of foliar application of zinc (B_0: 0 g ha^{-1}, B_1: 50 g ha^{-1}, $B_{2:}$ 60 g ha^{-1} and B_3: 70 g ha^{-1}) on spike length of wheat. These results are also in conformity with the findings of Ijaz *et al.* (2023) [3] where they found significant effect of foliar application of micronutrient mixture (Zn + Fe + Cu + B) on spike length of wheat.

Number of grains ear^{-1}

Number of grains ear^{-1} increased significantly and it was maximum in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron). Next to this treatment, treatments T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and treatments T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas the treatments T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in number of grains ear-1 at compare to control (T_1). These results are also in conformity with the findings of Javed *et al.* (2023) [4] where they found significant effect of foliar application of zinc (B_0: 0 g ha^{-1}, B_1: 50 g ha^{-1}, B_2: 60 g ha^{-1} and B_3: 70 g ha^{-1}) on number of grains of wheat. These results are also in conformity with the findings of Ijaz *et al*. (2023) [3] where they found significant effect of foliar application of micronutrient mixture (Zn + Fe + Cu + B) on number of grains of wheat.

Grain weight ear^{-1}

Grain weight ear-¹ was significantly highest in T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) are found at par with T_{12} when compared with control and rest of the treatments.

1000 grain weight

Significantly highest 1000 grain weight was noted in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron) are found at par with T_{12} when compared with control and rest of the treatments. Whereas, the Treatments T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$), T_5 (1% Boron) significantly higher in 1000 grain weight at compare to control (T_1). These results are also in conformity with the findings of Ijaz *et al*. (2023) [3] where they found significant effect of foliar application of micronutrient mixture (Zn + Fe + Cu + B) on 1000 grain weight of wheat.

Seed yield plant^{-1}

Seed yield plant^{-1} was significantly highest in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron) are found at par with T_{12} when compared with control and rest of the treatments. Whereas, the treatments T_{11} (1% MnSO4 + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in seed yield plant^{-1} at compare to control (T_1). These findings are also consistent with the results obtained by Shahgholi *et al.* (2023) [8] found Fe + Zn + B had the highest seed yield compared to single micronutrients treatment.

Seed yield plot^{-1} and ha^{-1}

Significantly maximum seed yield plot^{-1} and ha¹ was recorded in treatment T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron) and T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% $ZnSO_4$), T_7 (1% $CuSO_4$ + 1% $MnSO_4$), T_8 (1% $CuSO_4$ + 1% Boron) are found at par with T_{12} when compared with control and rest of the treatments. Whereas, the treatments T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$), T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in seed yield plot^{-1} and ha^{-1} at compare to control (T_1). These results are also in conformity with the findings of Karad *et al.* (2021) [5] where they found significant effect of foliar application of micronutrient mixture (0.5% $FeSO_4$ + 0.5% $ZnSO_4$) on seed yield of wheat.

Harvest Index

The range of harvest index obtained was 26.25 in control to 36.99% in treatment receiving T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron). The treatment T_{10} (1% $ZnSO_4$ + 1% Boron), T_9 (1% $ZnSO_4$ + 1% $MnSO_4$), T_6 (1% $CuSO_4$ + 1% Boron), T_7 (1% $CuSO_4$ + 1% $MnSO_4$) and T_8 (1% $CuSO_4$ + 1% Boron), T_{11} (1% $MnSO_4$ + 1% Boron), T_3 (1% $ZnSO_4$), T_2 (1% $CuSO_4$) are found at par with T_{12} when compared with control and rest of the treatments. Whereas, the treatments T_4 (1% $MnSO_4$) and T_5 (1% Boron) significantly higher in harvest index at compare to control (T_1). These results are also in conformity with the findings of Ijaz *et al.* (2023) [3] where they found significant effect of foliar application of micronutrient mixture (Zn + Fe + Cu + B) on harvest index of wheat.

Table 1: Effect of zinc, copper, manganese and boron on total chlorophyll content in leaves (mg g^{-1}), nitrogen content in leaves (%) and protein content in seeds (%) at harvest

Treatments	Biochemical analysis						
	Total chlorophyll content (mg g^{-1})			N content in leaves (%)			Protein Content in seeds (%)
	30 DAS	50 DAS	60 DAS	30 DAS	50 DAS	60 DAS	At harvest
T_1 (Control)	1.24	1.37	1.25	3.90	3.01	2.44	9.64
T_2 (1% $CuSO_4$)	1.33	1.46	1.38	3.91	3.06	2.46	9.82
T_3 (1% $ZnSO_4$)	1.35	1.50	1.40	4.28	3.78	3.04	10.58
T_4 (1% $MnSO_4$)	1.31	1.45	1.36	3.96	3.32	2.51	9.93
T_5 (1% Boron)	1.29	1.42	1.34	4.52	3.98	3.23	10.82
T_6 (1% $CuSO_4$ + 1% $ZnSO_4$)	1.41	1.58	1.46	4.38	3.88	3.10	10.75
T_7 (1% $CuSO_4$ + 1% $MnSO_4$)	1.40	1.56	1.45	3.99	3.43	2.55	10.39
T_8 (1% CuSO4 + 1% Boron)	1.38	1.53	1.44	4.22	3.75	3.00	10.58
T_9 (1% $ZnSO_4$ + 1% $MnSO_4$)	1.42	1.59	1.47	4.68	4.19	3.31	10.99
T_{10} (1% $ZnSO_4$ + 1% Boron)	1.43	1.60	1.48	4.59	4.12	3.24	10.92
T_{11} (1% $MnSO_4$ + 1% Boron)	1.36	1.51	1.41	4.15	3.59	2.87	10.55
T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron	1.46	1.61	1.52	4.75	4.29	3.41	11.13
SE(m) ±	0.04	0.05	0.05	0.20	0.20	0.18	0.31
CD at 5%	0.12	0.15	0.14	0.60	0.60	0.53	0.92

Table 2: Effect of zinc, copper, manganese and boron on number of spikelets ear^{-1}, spike length, number of grain $ears^{-1}$, grain weight ear^{-1}, 1000 grain weight, seed yield $plant^{-1}$(g), $plot^{-1}$(kg) and ha^{-1}(q), and harvest index (%)

Treatments	Number of spikelts ear^{-1}	Spike length	Number of grain $ears^{-1}$	Grain weight ear^{-1}	1000 grain weight
T_1 (Control)	15.99	7.67	32.10	1.86	39.25
T_2 (1% $CuSO_4$)	18.60	7.77	34.00	2.71	41.22
T_3 (1% $ZnSO_4$)	18.80	8.20	34.23	2.73	41.22
T_4 (1% $MnSO_4$)	18.12	7.60	33.73	2.61	41.14
T_5 (1% Boron)	17.78	7.80	33.47	2.57	41.02
T_6 (1% $CuSO_4$ + 1% $ZnSO_4$)	19.85	8.93	35.30	2.83	41.30
T_7 (1% $CuSO_4$ + 1% $MnSO_4$)	19.73	8.80	35.07	2.82	41.64
T_8 (1% $CuSO_4$ + 1% Boron)	19.68	8.60	34.37	2.81	41.62
T_9 (1% $ZnSO_4$ + 1% $MnSO_4$)	19.81	9.17	35.83	2.84	42.66
T_{10} (1% $ZnSO_4$ + 1% Boron)	20.45	9.47	36.30	2.85	45.86
T_{11} (1% $MnSO_4$ + 1% Boron)	19.15	8.43	34.27	2.74	41.58
T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron	20.70	9.63	37.13	2.89	46.99
SE(m)	0.80	0.34	0.87	0.12	1.23
CD	2.35	1.01	2.57	0.35	3.62

Table 3: Effect of zinc, copper, manganese and boron on seed yield $plant^{-1}$(g), $plot^{-1}$(kg) and ha^{-1}(q), and Harvest index (%) at harvest

Treatments	Seed yield $plant^{-1}$(g)	Seed yield $plot^{-1}$(g)	Seed yield Ha^{-1}(g)	Harvest index (%)
T_1 (Control)	5.89	1.22	29.43	26.25
T_2 (1% $CuSO_4$)	4.0.	1.27	30.69	29.98
T_3 (1% $ZnSO_4$)	6.25	1.29	31.23	30.29
T_4 (1% $MnSO_4$)	6.10	1.26	30.49	28.14
T_5 (1% Boron)	5.92	1.24	30.08	27.88
T_6 (1% $CuSO_4$ + 1% $ZnSO_4$)	6.71	1.38	33.53	35.52
T_7 (1% $CuSO_4$ + 1% $MnSO_4$)	6.56	1.36	32.81	35.33
T_8 (1% $CuSO_4$ + 1% Boron)	6.30	1.34	32.48	34.06
T_9 (1% $ZnSO_4$ + 1% $MnSO_4$)	6.84	1.41	34.07	36.22
T_{10} (1% $ZnSO_4$ + 1% Boron)	6.86	1.42	34.32	36.24
T_{11} (1% $MnSO_4$ + 1% Boron)	6.26	1.32	32.08	33.02
T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + 1% Boron	6.94	1.44	34.69	36.99
SE(m)	0.25	0.05	1.16	2.31
CD	0.72	0.15	3.41	6.78

Conclusion

The significant biochemical parameter has been observed by the foliar sprayed to T_{12} (1% $CuSO_4$ + 1% $ZnSO_4$ + 1% $MnSO_4$ + Boron) to increase chlorophyll content of leaves at all stages *i.e*., 30, 50 and 70 DAS and T_{10} (1% $ZnSO_4$ + 1% Boron) was found most effective among all treatments to increase leaf nitrogen content at all stages *i.e*., 30,50 and 70 DAS and protein content of seed in wheat.

References

1. Bruinsma J. A comment on spectrophotometric determination of chlorophyll. Bio-chem., Bio-phy., Acta. 52: 576-578 Cakmack, I. 2002. Plant nutrition research: Priorities to meet human needs for food in sustainable ways. J. Plant and Soil. 1982;247:3-24.
2. Farhan HN, Salim SA, Alalwany AAM, Abdullah BH, Aobad HM. Effect of boron on the yield of wheat

(*Triticum aestivum* L.) under center pivot sprinkler irrigation system in the West Desert of Iraq; c2021.
3. Ijaz B, Shahid Nazeer MS, Nadeem M, Anwar H, Idrees M, Nawaz M, Khan RHU. Effect of various foliar applied micronutrients (Zn + Fe + Cu + B) on growth and yield of wheat under Faisalabad condition; c2023.
4. Javed MS. Impact of Foliar Application of Boron on Productivity of Different Varieties of *Triticum aestivum* L. Haya Saudi J Life Sci. 2023;8(6):84-88.
5. Karad VS, Shende PV, Kesarkar AP, Madke VS, Tupkar SD. Influence of ferrous sulphate and zinc sulphate on morpho-physiological parameters and yield in chickpea. J Soils and Crops. 2021;32(1):184-192.
6. Panse VG, Sukhatme PV. In statistical method for agricultural worker ICAR publication, New Delhi. 2nd Philips, J.D.J; c1954. p. 63-66.
7. Pise SE, Shende PV, Deotale RD, Manapure PR, Madake VS, Raut DA, *et al*. Response of zinc and iron on chemical and biochemical, yield contributing parameters and yield of lathyrus (*Lathyrus sativus* L.). J Soils and Crops. 2020;30(1):165-171.
8. Shahgholi S, Sayfzadeh S, Hadidi E Masouleh, Shahsavari N, Zakerin H. Assessment of Zinc, Boron, and Iron Foliar Application on Wheat Yield and Yield Components Under Drought Stress. Communications in Soil Science and Plant Analysis. 2023;54(9):1283-1292.
9. Somichi Y, Doughlus SY, James AP. Laboratory manual. Physiological studies in rice analysis for total nitrogen (organic N) in plant tissue. The Inter Res. Instit. Los Banos, Languna, Phillipine: II; c1972.
10. Tahir M, Naveed MT, Sheikh AA, Maqbool R. Growth, Yield and Quality Response of Three Wheat Varieties to Foliar Spray of Micro Nutrients. Biological Sciences-PJSIR. 2021;64(1):49-54.