

Original Paper



Effect of foliar and soil application of zinc on biochemical contents, macro nutrients and growth performance of *Triticum aestivum* L.

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Abstract

The aims of the present study are to determine the effect of zinc both applied foliar and soil on biochemical contents, macro nutrients and physiological parameters of selected wheat variety (Jauhar 16). Wheat seeds were sown in pots filled with 1kg of air dried soil with triplicates in the botany department of Bacha Khan University Charsadda, Pakistan in wheat growing season of 2019. Results showed that the foliar application had positive effect on current parameters. Maximum biochemical contents were comparatively increased in foliar applied Zn at (30 and 35ppm). While macro nutrients are also significantly increase with foliar applied Zn up to (30ppm). During this study morphological parameters were enhanced by lower foliar Zn applications at (20ppm). From the current study it is concluded that foliar application is more beneficial than the soil applied Zn application for wheat plant.

Key-words: Foliar, Zinc, Biochemical Contents, Macro Nutrients Growth Performance *Triticum aestivum* L

Introduction

Triticum aestivum (wheat), also called “The king of cereals” is close by known as “Ghandum”. It is the leading earth planet food crop. The acceptance of *Triticum aestivum* as an essential food stuff led to its wide extend dissemination as food aid to increasing countries (Sud et al., 1990). Wheat is one of the third key cereal crops worldwide and be in contact chief dietary source of calories (21%), proteins (20%) and micronutrients for the best part of world’s population, particularly in the developing world (Shewry, 2009). Wheat is answerable up to 70 % of daily calorie intake of the population living in rural regions and an essential Zn for human beings living in the developing world (Cakmak, 2008). For example, wheat-based food

products provide more than 20 % of dietary Zn in China (Ma et al., 2008).

Zinc a vital factor for the normal plants of growth. It plays key role in enzyme stimulation and also involved in the synthesis of some enzymes and hormones development (Marschner, 1995). Whole absorption of Zn is sufficient in many agricultural areas, but available Zn concentration is deficient because of different climatic and soil conditions. Soil pH, lime content, organic matter amount, clay type amount and the amount of applied phosphorus fertilizer affect the availability of Zn concentration in soil (Adiloglu et al., 2006).

In soil Zn shortage is very common in cereal based cropping system (Cakmak, 2002).

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Zinc deficiency is a prevalent micronutrient deficiency in wheat, leading to severe reduction in wheat production and nutritional quality of grains (Cakmak et al., 1996). Wheat is the most widely grown cereal crop in the world and as a staple food it is second only to rice in consumption. Generally, the regions with severe zinc-deficient soils are also the regions where zinc deficiency in human beings is very common. Therefore, there is a great need to improve cereal crops with adequate zinc nutrition.

Zinc (Zn) insufficiency is a serious problem of micronutrient in human health everywhere, which affects more than one-third of the world's population (Hotz and Brown, 2004). There is a close geological overlap between global distribution of Zn deficiency in soil and humans (Alloway, 2008; Cakmak, 2008). Which highlights the core linkage among agriculture, food crops and human health (Welch, 2008).

In research reported that human Zn deficiency is widespread mainly in areas where cereal based foods are dominant in the diet (Bouis, 1996; Cakmak, 2008; Gibson, 2006).

The utilization of macro and micronutrients nourishment in the development region may not be fulfilling the crop necessary. The different method is to engage these nutrients as foliar sprays. Soil plus foliar applications of micronutrient have been described to be equally or even more sufficient as soil application (Firdous et al., 2016). Foliar-applied nutrients have limited direct use for enhancement of stress resistance mechanisms in field crops. Among the micronutrients, Zn nutrition can affect the weakness of plants to drought stress (Sultana et al., 2001; Khan et al., 2003; Cakmak, 2008). Foliar zinc application greatly affects plant growth and crop production.

It is, therefore, important to study the effectiveness of foliar application of zinc on yield of wheat under H₂O stressed condition at various growth stages of the yield.

Materials and Methods

Experimental design

The green house experiment was conducted in the botanical garden of Bacha Khan University Charsadda having (latitude 34.1509 N, longitude 71.735 E, altitude 908 feet) during the wheat growing season (winter) of 2019 in the month of November under natural light conditions when the average temperature was 22°C. Seeds of wheat were sown equidistantly at 2 cm depth in pots of (2cm lower inside diameter, 23 cm upper diameter, 25cm height, and 18cm in thickness). The pots were filled with 1kg of clay loamy soil. The soils were analyzed having sand 36.36% silt 10.90% and clay was 52.72%. No additional supplement was added to the experimental soil. The soil pH was normal (7). The soils were treated with Zinc applied at the doses of 4, 8 12mg/kg in soil and applied to three pots as foliar spray given at vegetative stage at the dose of 20, 30, 35ppm. Each treatment was replicated three times in Randomized Complete Block Design. Pot without the addition of B constituted the control.

Soil Analysis

The soil was analyzed in order to study the nutritious status of the soil such as nitrogen, phosphorus, potassium etc, organic content and also important micro nutrient inside the soil. Soil samples were analyzed before fertilizer application.

Table 1. Chemical and physical properties of the experimental soil.

Property	Value	Property	Value	Property	Value
C	10.05%	Al	6.29 %	PH	6.9
N	3.99 %	Si	14.53 %	Porosity	45 %
O	59.93 %	P	0.61 %	Sand	27.15%
Na	0.69 %	K	1.02 %	Silt	19.86%
Mg	1.86 %	Ca	1.03 %	Clay	52.98%

Morphological Parameters of Wheat under Zinc effect

Detailed agronomic characterization of wheat under zinc effect was performed including Leaves no, Nodes no, Tiller no, Spikes no, Plant height, Leaf area, Leaf length and Leaf width.

Biochemical analysis

- Chlorophyll a, b content of leaves was determined by the method of Arnon (1949).
- Protein content of leaves was determined by the method of Lowery et al. (1951) using BSA as standard.
- Proline content of leaves was determined by the method of Bates et al. (1973).
- Phenol content was determined according to the Folin–Ciocalteu method as described by (Mahadevan and Sridhar. 1982).

Elemental analysis

As per protocol of (Model Perkin Elmer AA Analyst 700) the samples were determined by using Atomic Absorption Spectrophotometer at CRL lab, Department of Physics, University of Peshawar, Pakistan.

Statistical analysis

All the data collected were analyzed by using randomized complete block design. Results were submitted for analysis of variance (ANOVA) using STATISTIX 8.1. When the ANOVA showed a statistical effect, means were separated by least significant differences (LSD) at $P < 0.05$.

Result And Discussion

Zinc application had positive effect on plant growth to increased leaf area, plant height, number of tillers, number of spikes, and number of nodes. Micronutrients are essential for plant growth and play an important role in the balanced crop nutrition. Zinc is an important micronutrient and play a key role in crop production, or as a

structural, functional, or regulatory cofactor of many enzymes. Our results are in agreement with those reported by (Asad and Rafique, 2000 and Curtin et al., 2008). Mann RA (2004) reported that quantity of spike of different variety increased positively with the application of zinc.

Morphological Parameters (Figure 1)

Foliar Zn application had positive effect on leaves no of wheat variety (Jauhar 16). The result show that maximum leaves no were observed in foliar applied up to 20ppm (3.665) while minimum leaves no were recorded in control (1.6667). These result are same with the view of reported that foliar application of micronutrients Zn increased leaves no. (Hemantaranjan and Garg, 1988) also observed that foliar application of zinc, wheat had greater leaves no compared to the control. Our results showed that application of foliar spray has greater number of nodes compared to the control. The greater number of nodes present in foliar applied treatment 20ppm (2.667) as compared to the control (2.000). (Silsipoor, 2008) reported that foliar application of micronutrients Zn increased in wheat number of nodes.

Consequence showed that soil applied zinc application have significant impact on number of spike of wheat varieties. Higher number of spikes was recorded in treatment 4mg/kg (2.6667) while minimum were recorded in control (0.6667). It was found from the results that wheat treated with soil or foliar application of zinc gave more tillers, the highest number of tillers were recorded in foliar applied treatment 20ppm (3.000) while lower number of tillers were recorded in control (0.666). (Hasanuz zaman, M et al., 2010) reported that nutrient concentration is effective in improving number of tillers per plant. The analysis of variance revealed that plant height (cm) had significant positive effect by foliar application of Zn solutions. Maximum plant height (46.667) recorded in those plots which were sprayed with 0.35% Zn solution, while was minimum plant height was recorded in control (30.667). (Abbas, G et al., 2005) reported that plant tallness increasing considerably with increased of Zn rate. This might be due to foliar application of Zinc solution to increase the length

of stem at boot stage which in turn resulted in maximum plant height (Hasina Gul et al., 2006).

Results showed that foliar application wheat had greater leaf area index (mm) compared to the control treatment. Maximum leaf area was obtained in (38.167) foliar applied treatment 20ppm which was significantly higher than control (23.200). Hemantaranjan and Garg (1988) also practice that foliar application of zinc, wheat had greater leaf area index compared to the control.

The leaf length and leaf width of wheat plant were maximum in foliar applied treatment 20ppm (15.000, 7.4667) while minimum leaf length and leaf width were observed in control (9.000, 2.3667).

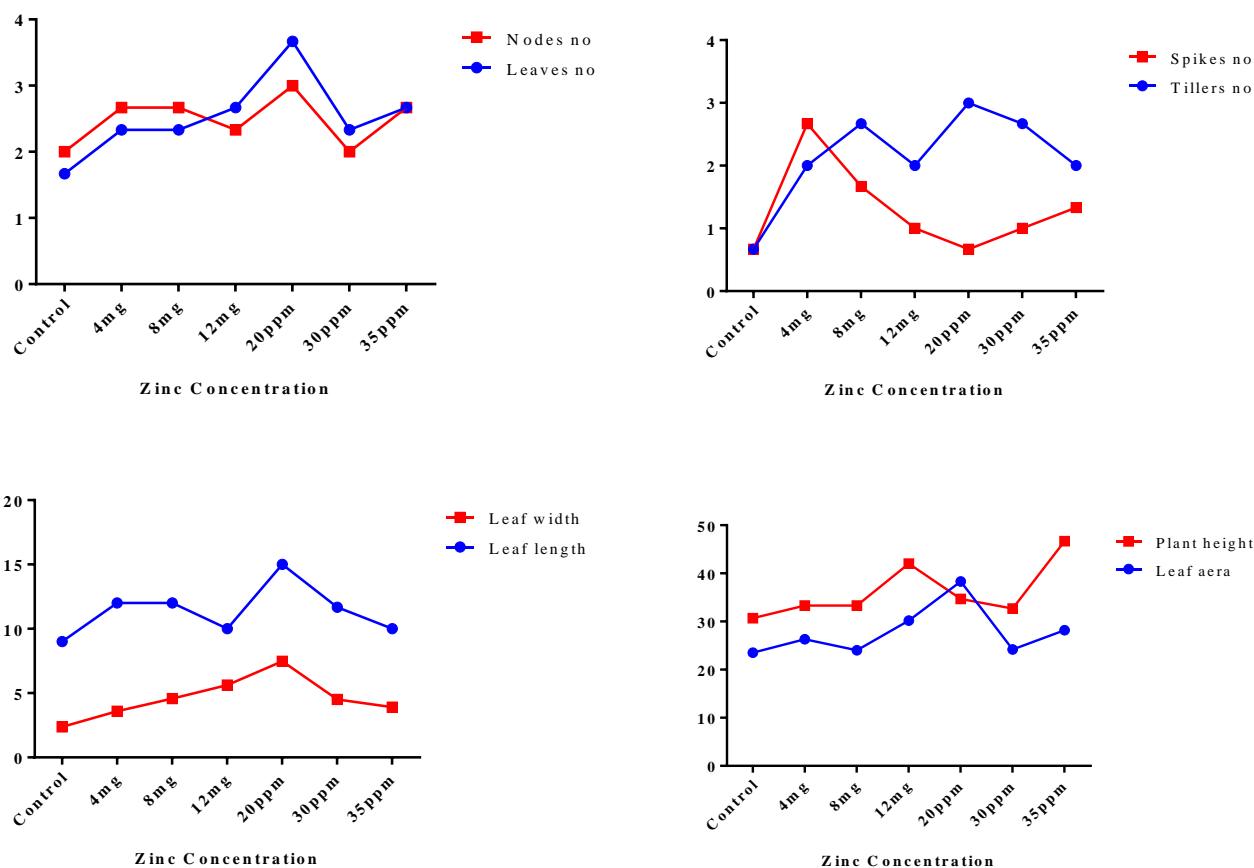


Fig. 1. Effect of different concentration of soil and foliar applied zinc on leaves no, nodes no, tillers no, spikes no, leaf length (cm), leaf width (cm), leaf area (mm)², and plant height (cm) of wheat plant.

Biochemical Contents

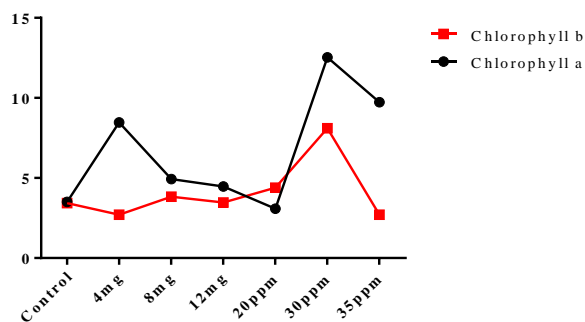
The results for the chlorophyll a, b content (mg/g) showed significant difference for the various treatments applied as soil application as well as foliar application of Zn. The highest chlorophyll-a content (12.533) was received for foliar treatment 30ppm. The lowest chlorophyll a content (3.5000) was received for control. The highest chlorophyll b content (8.1000) was received for foliar treatment 30ppm. The lowest chlorophyll b content (2.4333) was received for control. (Kandolia RU., 2018) prove that Zn

applications either as soil or foliar application increased the chlorophyll a/b content of wheat.

The highest protein content was recorded in foliar applied treatment 35ppm (19.0667) which was higher than the control treatment (12.3667). (Zeidan et al., 2010) indicated that application of Zn elements was significantly increased the protein content in grain. These results are in line to the findings of (Rogalsaki L. et al., 1994) who declared that application of zinc significantly increases grain protein contents. These results are well supported by the findings of (Shamsa et al., 2010) who

describe that use of ZnSO₄ force be a feasible choice to improve contents protein in grains.

Statistical analysis showed that 30ppm (40.713) have higher proline contents as compared to control (11.4000), which indicates that zinc has positive role on proline contents. It means that foliar zinc application increases the proline contents.



The result was supported by (Bassi and Sharma, 1993). Our result revealed that maximum phenol contents were found in foliar application 35ppm (30.2700) compared with soil applications and control which indicates that foliar zinc application increases the phenolic contents. Our result also supported by (Dongyun et al., 2017) showed that zinc soil and foliar applications enlarge the total phenol content

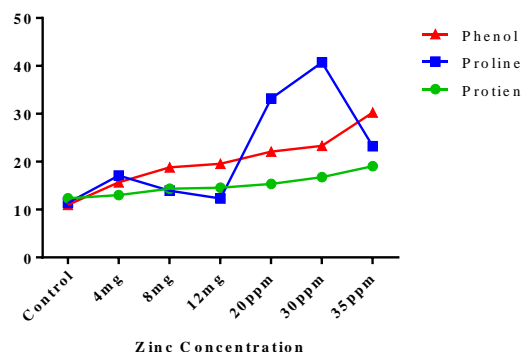


Fig. 2. Effect of different concentration of soil and foliar applied zinc on chlorophyll a b (mg/g), protein (mg/g), proline (mg/g), and phenol (mg/g) of wheat plant.

Elemental analysis (Macro nutrients)

Current studies indicated that the foliar Zinc application have positive role on elemental analysis (macro nutrients) of wheat variety (Jauhar 16). Macro nutrients of seed (Carbon, Nitrogen, Oxygen, Magnesium, Phosphorous, Sulphur, Chlorine, Potassium, Calcium) were linearly increase with foliar applied Zn at sufficient concentration (30ppm). While minimum nutrients of (Carbon, Nitrogen, Oxygen, Magnesium, Phosphorous, Sulphur, Chlorine, Potassium, Calci

um) were observed at soil Zn concentration and control. These results are same with the views of (Abbas et al., 2009). Reported that the phosphorous and nitrogen increased with the increase in zinc content. The result indicates that zinc treatments have significant effects on potassium content. Which indicates that zinc foliar application significantly increases the potassium content in wheat grains, our results also confirm the findings of (Keram et al., 2013).

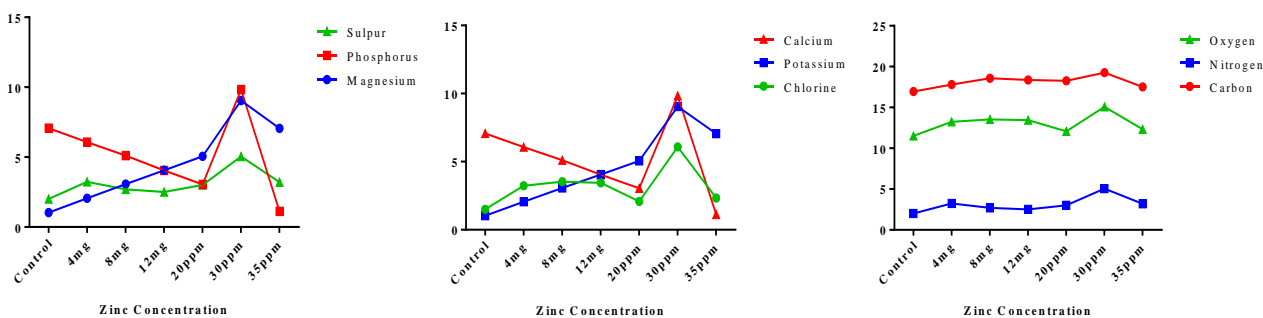


Fig. 3. Effect of different concentration of soil and foliar applied zinc on carbon, nitrogen, oxygen, magnesium, phosphorus, sulphur, chlorine, potassium and calcium of *Triticum aestivum* L.

Conflict of interest: The authors declared that there was no conflict of interests regarding the publication of this paper.

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