National Journal of Advanced Research
ISSN: 2455-216X
Impact Factor: RJIF 5.12
www.allnationaljournal.com
Volume 4; Issue 1; January 2018; Page No. 66-69

Effect of soil applied zinc on the yield of wheat (*Triticum aestivum* L.) varieties

[1] Faraz Ahmed Pathan, [2] Riaz Hussain Mari, [3] Abdul Shakoor Shar, [4] Naseem Khatoon, [5] Aneela Yousaf, [6] Saira Memon, [7] Sajjad Ahmed

[1, 2, 3, 5] Institute of Food Sciences and Technology, Sindh Agriculture University Tandojam, Pakistan
[4] Institute of Biotechnology and Genetic Engineering University of Sindh, Pakistan
[6, 7] Department of Farm Power and Machinery, Sindh Agriculture University, Tandojam, Pakistan

Abstract

A field study was laidout to assess the impact of soil applied zinc on the yield of wheat varieties at student's experimental farm, Department of Agronomy, Sindh Agriculture University Tando jam during the year 2015-16, was laidout in three replicated randomized complete block design (factorial) having net plot size of 9 m^2. The treatments were five zinc levels i.e (0 kg ha^{-1} (control), 1 kg ha^{-1}, 1.5 kg ha^{-1}, 2 kg ha^{-1} and 2.5 kg ha^{-1}) and two wheat varieties (Sehar and Abdul Sattar). The observations were recorded on important growth and yield contributing characters viz: germination (%) m^2, no of tillers m^{-2}, plant height (cm), spike length (cm), spikelets $spike^{-1}$, grains $spike^{-1}$, Seed index (1000 grains wt,g) and Grains yield (kg ha^{-1}). The result of the study indicated that all the growth and yield traits were significantly ($P < 0.05$) affected by zinc levels. It was observed that wheat crop delivery 2.5 kg ha^{-1}, zinc result in 82.60 (%) germination, numbers of tillers 356 m^{-2}, 102 cm plant height, 11.40 cm spike length, 27 spikelets $spike^{-1}$, 81 grains spike, 41 g seed index, 6104 kg ha^{-1} grains yield. In the same way, the wheat receving 1 kg ha^{-1} zinc result in 80.40 (%) germination, numbers of tillers 256 m^{-2}, 73.30 cm plant height, 7.40 cm spike length, 19 spikelets $spike^{-1}$, 57 grains spike, 26 g seed index, 3230 kg ha^{-1} grains yield. These parameters are lowest except control. However, the interaction among the wheat variety the best response Sehar in germination 80.88 (%), numbers of tillers 291 m^{-2}, plant height 81.81 cm, spike length 8.28 cm, spikelets $spike^{-1}$ 22.20, grains spike 66.60, seed index 31.20 g, grain yield 4131.20 kg ha^{-1}. Such as the wheat variety Abdul Sattar were showed 80.51 (%) germination, numbers of tillers 272.20 m^{-2}, 80.24 cm plant height, 8.06 cm spike length, 20.40 spikelets $spike^{-1}$, 61.20 grains spike, 29.80 g seed index, 3682.20 kg ha^{-1} grain yield. It was proved from the research work that Sehar variety produced high performance than that of wheat variety abdul sattar.

Keywords: wheat (*Triticum aestivum* L.), soil, zinc

Introduction

Wheat (*Triticum aestivum* L.) is essential and provided more nutrient sch as protein injestion the entire world (FAO, 2014) [12]. Wheat is cultivated about ten thousand years ago as part of 'Neolithic Revolution' (Shewry, 2009) [26]. The first cultivated forms were diploid, tetraploid and developed from the Southeastern part of Turkey (Dubcovsky and Dvorak, 2007) [10]. Wheat makes up 30% of the world's total cereal production (Shewry, 2009) [26]. On a global average, 20% of the daily calorie intake originates from wheat products. However, this proportion can reach upto 60% in world areas, where wheat constitutes the main staple crop (FAO, 2014) [12].

The deficiency of Zn in soil is a generally reserve for the production of wheat (*Triticum aestivum* L.) especially in the region of semiarid and aired regions. Where the Ph of the soil and the content of $CaCO_3$ are high and lower the content of organic matter (Cakmak *et al*., 2001) [8]. The deficiency of Zinc in soil decreased the yield and grain quality (Lombnas and Singh, 2003) [20]. It is most lead to in human consumpation Zn deficiency, particularly in developing countries because their diets dependes on the cereal-based foods. (Acklandand and Michalczyk, 2006) [2]. To identify the efficiency of Zn in the first step of genotypes of wheat from existing in genetic resources (Cakmak *et al*., 2001) [8]. Pakistani soils are alkaline a as deficiency of Zinc is extremely cereals are grown mostly in calcareous soil (Maqsood *et al*., 2009) [21]. The factors of soil influencing the amount and avibility the crops such as wheat which are grown on the soil of calcareous and rice grown in lowland on soils of flooded highly prone to deficiency of Fertilizer of Zinc is mostly provide overcome the zinc deficiency in the creals (Alloway, 2009) [3].

Zinc is the important component for many enymes like aldolases, dehydrogenases, transphosphorylases, isomerases, RNA and DNA polymerases (Broadley *et al*., 2007) [5]. It is included in regulating the tolerance against stresses and genes (Broadley *et al*., 2007) [5]. The deficiency of Zinc affects plant growth and crop yields. It also badly affects the yield and reduces the quality of the protein contents in grain crops size and appearance of fruits. The plants which contain low Zinc amount are more sensitive of fungal diseases as well as photo- and heat damage (Alloway, 2009) [3]. The symptoms of Zn deficiency like stunted growth and chlorotic discoloration of leaves. Therefore, the deficiency of the quantity of yield of may be decreased impaired the yield quality without any symptoms; a plant Zn status, which was defined as 'hidden' deficiency (Alloway, 2009) [3]. Zn contributes in synthesis of protein and energy production (Broadley *et al*., 2007) [5]. The deficiency of Zn of can be distributed into five major pools. The Zinc which is soluble water, solution of the of the soil solution, exchangeable Zn are electrostatically bound to the soil particles. Zn affiliated with dray minerals like carbonates and insoluble Zn associated with the metal oxides, chelated Zn and organically bound Zn adsorbed to organic ligands. The primary minerals are present in Zn residue (Alloway, 2009) [3]. Salts are form by zinc such as nitrate, chloride, sulfate, phosphate and become chelated by organic compounds (Alloway, 2009) [3]. The properties of soil influencing the Zn redox, pH conditions and the contents of calcite ($CaCO_3$), organic matter and microbial activity also the concentrations macro-nutrients (especially P) clay content salinity and soil moisture (Houben and Sonnet, 2012) [15].

Intra-plant Zn remobilization from vegetative to generative tissue comes probably second in importance as a determinant of grain Zn concentration after Zn uptake from soil and it influenced in many ways (Erenoglu *et al*., 2011) [11]. Micro nutrient deficiencies like zinc (Zn) cause Diverse health problems and remain highly prevalent worldwide, affecting over 2 billion people, particularly children and women (Broadley *et al*., 2007) [5]. Inc Malnutrition not only impairs human health, well being and physical performance, but also poses a very significant economic burden, especially on poorer nations. The application of foliar Zn fertilizer was increased grain Zn that can significantly contribute to dietary Zn Intake (Phattarakul *et al*., 2012) [24]. The most important wheat yield-determinant factors are the photosynthetically activeirradiation, water supply, nutrient availability and temperature. On the contrary, wheat yield is most widely reduced in consequence of drought, soil salinity, low N supply, high soil pH, and low Zn availability, which are production-limiting factors of particular relevance.

Root growth and surface area are important for Zn uptake by plants, because Zn bioavailability is mainly limited by poor mobility, which makes active foraging necessary. Root architecture that may differ among crop plant species and cultivars plays an important role in Zn uptake (Hacisalihoglu and Kochian, 2003) [14]. Besides root morphology and architecture, also exudation patterns may influence Zn uptake by plants. Influences of roots on Zn availability in soil may be mediated directly via alterations to soil pH and chelation by organic ligands, or indirectly via stimulation of soil microbial growth (Hacisalihoglu and Kochian, 2003) [14].

For wheat, it has been reported that it reused in the plant leaves of tissue phloem. Tissuesd are particular importance for Zn allocation grains (Ondrasek and Rengel, 2012) [23]. Grain Zn sink activity during grain filling has been suggested as the driving force behind Zn re-translocation (Erenoglu *et al*., 2011) [11]. Nicotianamine, the precursor of mugineic acid, involvement of the N-rich nicotinamide in intra-plant Zn translocation is, in fact, though to be the reason why a sufficient N supply is so important for the plant internal Zn remobilization (Cakmak *et al*., 2010) [6, 7].

The Zn concentration target for wheat suggested by the HarvestPlus program is 38 mg kg^{-1} (Bouis and Welch, 2010) [4]. Findings of this research program are that several genes control Zn concentration in wheat, and that the heritability of this trait is of intermediate magnitude (Cakmak *et al*., 2010) [6, 7]. Although, transgenic breeding approaches have the potential to increase grain Zn concentrations in cereals, it is questionable whether genetically improved cultivars will succeed in producing more Zn-rich grains, when Zn uptake is primarily limited by a very low availability of Zn in soil (White and Broadley, 2011) [27]. Therefore, it may well be that first agronomic soil fertility management is needed before cultivar selection; breeding and transgenetic approaches can be utilized (White and Broadley, 2011) [27].

Materials and Methods

The field experiment was conducted at student's experimental farm, Department of Agronomy, Sindh Agriculture University Tando Jam to assess the "Impact of soil applied zinc on the yield of Wheat (*Triticum aestivum* L.) Varieties" during 2015-16. The experimental details are given as under:

Experimental design =Randomized Complete Block Design (RCBD) factorial

Replications = 03

Plot size = 3 m x 3 m= (9 m^2)

Treatments Two factors (A and B)

Factor-A: Zinc levels (Zn) = 5

Zn_1 = 0 kg ha^{-1} (Control)
Zn_2 = 1 kg ha^{-1}
Zn_3 = 1.5 kg ha^{-1}
Zn_4 = 2 kg ha^{-1}
Zn_5 = 2.5 kg ha^{-1}

Factor-B: Varieties (V) = 2

V_1 = Sehar
V_2 = Abdul Sattar

Treatment Combinations

T_1= Zn_1 V_1	T_2= Zn_2 V_1	T_3= Zn_3 V_1	T_4= Zn_4 V_1
T_5= Zn_5 V_1	T_6= Zn_1 V_2	T_7= Zn_2 V_2	T_8= Zn_3 V_2
T_9= Zn_4 V_2	T_{10}= Zn_5 V_2		

Cultural Parctice

The land was prepared by two dry plowing by precision land leveling. After soaking dose, when soil reached proper moisture lavel, two plowings with cultivator plow were done to achieve the fine seedbad. The uniform seed of wheat varieties was sown at the rate of 125 kg ha^{-1} with single row hand drill on December 2015, maintaining row to row distance 0f 22.5 cm. The recommended dose of N and P (168-75-0 kg ha^{-1}) was applied from Urea and DAP. All phosphatic $^1/_3$ of nitrogen was applied at the time of sowing and for Zn ($ZnSo_4$) was also applied at the time of sowing where as, remaining nitrogen was applied in two equal splits at 1st and 2nd irrigation. All other agronomic practices were followed as per requirements.

Observations were recorded

1. Germination % (m^2)
2. No of tillers (m^{-2})
3. Plant height (cm)
4. Spike Length (cm)
5. Spikelets $spike^{-1}$
6. Grains $spike^{-1}$
7. Seed index (1000 grains wt, g)
8. Grains yield (kg ha^{-1})

Statistical analysis

The data was statistical analysis using by Statistic 8.1 computer software (Statistix, 2006).

Results

It was examined that the wheat as effected by soil applied zinc on the wheat varieties of sehar and A.sattar the germination % (m2) was recorded in between (80.88-80.5). The maximum germinatinon 80.88 in sehar and mininmum 80.5 in A. sattar was recorded. It was noticed that the mininmum No of tillers (m-2) 272 in A.sattar and maximum at about 291 in sehar was recorded. The Plant height (cm) 81.81 was recorded as highest in sehar and low in A.sattar. Spike Length (cm) was recorded in between (8.28 to 8.06), highest 8.28 in sehar and 8.06 as lowest in A.sattar was recorded. It was also noticed that Spikelets spike-1 22.20 is highest and 20.40 as lowest was recorded in sehar and A.sattar. Grains spike-1 by soil-applied zinc on the wheat varieties was recorded as higest 66.60 in sehar and lowest 61.20 was in Asattar. The Seed index (1000 grains wt, g) 31.20 as higest in sehar and lowest 29.80 in A.sattar was recorded. It was noticed that the Grains yield (kg ha-1) of soil applied zinc on the wheat varieties of sehar and A.sattar in between (4131 to 3682). The highest Grains yield (kg ha-1) 4131 was recorded in sehar and lowest 3682 was in sehar wheat variety.

Table 1

Parameters	Wheat varieties	
	Sehar	A. Sattar
Germination % (m^2)	80.88 A	80.5 A
No of tillers (m^{-2})	291 A	272 B
Plant height (cm)	81.81 A	80.24 B
Spike Length (cm)	8.28 A	8.06 B
Spikelets spike^{-1}	22.20 A	20.40 B
Grains spike^{-1}	66.60 A	61.20 B
Seed index (1000 grains wt, g)	31.20 A	29.80 B
Grains yield (kg ha^{-1})	4131 A	3682 B

Discussion

Fertlizers is most essential factor enhancing the quantity and quality of products of crops. The trace elements are important to maintaining the optimum physiology of plants. Zinc (Zn) has essential and appear good character of enhancing the enzymes and work as a co-factor of enzymes (Grotz and Guerinot, 2006) [12]. Height of plant is the main parameter of wheat plant growth, which shows the variation in gentic, and effects of fertilizer. The maximum height of plant is due to due to the contribution of Zn in various physiological processes such as activation enzymes (Yassen *et al*., 2010) [29]. Opening and closing of stomata and formation of chlorophyll, which leads to increase the plant height (Yaseen *et al*., 2011) [28].

The result of the study indicated that all the growth and yield traits were significantly ($P < 0.05$) affected by zinc levels. It was observed that wheat crop delivery 2.5 kg ha^{-1}, zinc result in 82.60 (%) germination, numbers of tillers 356 m^{-2}, 102 cm plant height, 11.40 cm spike length, 27 spikelets spike^{-1}, 81 grains spike, 41 g seed index, 6104 kg ha^{-1} grains yield. In the same way, the wheat receving 1 kg ha^{-1} zinc result in 80.40 (%) germination, numbers of tillers 256 m^{-2}, 73.30 cm plant height, 7.40 cm spike length, 19 spikelets spike^{-1}, 57 grains spike, 26 g seed index, 3230 kg ha^{-1} grains yield. These parameters are lowest except control. However, the interaction among the wheat variety the best response Sehar in germination 80.88 (%), numbers of tillers 291 m^{-2}, plant height 81.81 cm, spike length 8.28 cm, spikelets spike^{-1} 22.20, grains spike 66.60, seed index 31.20 g, grain yield 4131.20 kg ha^{-1}. Such as the wheat variety Abdul Sattar were showed 80.51 (%) germination, numbers of tillers 272.20 m^{-2}, 80.24 cm plant height, 8.06 cm spike length, 20.40 spikelets spike^{-1}, 61.20 grains spike, 29.80 g seed index, 3682.20 kg ha^{-1} grain yield. It was proved from the research work that Sehar variety produced high performance than that of wheat variety abdul sattar.

Abbas *et al*. (2009) [1] observed the improved wheat growth and yield with the application of zinc fertilizer. Rahimi *et al*. (2012) [25] observed that application of zinc fertilizer improved the number of tillers of wheat. Culminating in more dry matter and grain yield production in cereals (Khan *et al*., 2010). Progressive increase in Zn grain contents might be due to higher soil Zn contents due to external soil Zn application compared with control. Moreover, different Zn grain contents in divergent wheat cultivars under control and varying levels of Zn application indicated the relative acquisition efficiencies of these genotypes from a Zn deficient and fertilized soil. Efficient genotypes such as Bhakar-2002 and Lasani-2008 accumulated more Zn contents in grains (Maqsood *et al*., 2009) [21].

Conclusion

It concluded that impact of soil applied zinc on the yield of wheat (*Triticum aestivum* L.) varieties that the delivery was germination, numbers of tillers, plant height, spike length, spikelets spike^{-1}, grains spike, seed index and grains yield were higher in the sahar than the A. sattar. It was proved from the research, Sehar variety produced high performance than that of wheat variety Abdul Sattar.

References

1. Abbas G, Khan MQ, Jamil M, Tahir M, Hussain F. Nutrient uptake growth and yield of wheat (*Triticum aestivum*) as affected by zinc application rates. Int. J Agric. Bio. 2009; 11:389-39.
2. Ackland ML, Michalczyk A. Zinc deficiency and its inherited disorders a review. Genes and Nutr. 2006; 1(1):41-50.
3. Alloway BJ. Soil factors associated with zinc deficiency in crops and humans. Environ. Geochem. Health. 2009; 31:537-548.
4. Bouis HE, Welch RM. Biofortification A sustainable agricultural strategy for reducing micronutrient malnutrition in the global south. Crop Sci. 2010; 50:20-32.
5. Broadley MR, White PJ, Hammond JP, Zelko I, Lux A. Zinc in plants new phytol. 2007; 173:677-670.
6. Cakmak I, Kalayci M, Kaya Y, Torun AA, Aydin N, Wang Y, *et al*. Biofortification and localization of zinc in wheat grain. J Agri. and Food Chem. 2010; 58:9092-9102.
7. Cakmak I, Pfeiffer WH, McClafferty B. Biofortification

of durum wheat with zinc and iron. Cereal Chemistry. 2010; 87:10-20.

8. Cakmak O, Ozturk L, Karanlik S. Tolerance of 65 durum wheat genotypes to zinc deficiency in a calcareous soil. J Plant Nutr. 2001; 24(11):1831-1847.
9. Chauhan TM, Singh SP, Javed A. Differential response of wheat cultivars to Zinc application alluvial. Soil Annals Plant Soil Res. 2013; 15(2):152-155.
10. Dubcovsky J, Dvorak J. Genome plasticity a key factor in the success of polyploid wheat under domestication. Sci. 2007; 316:1862-1866.
11. Erenoglu EB, Kutman UB, Ceylan Y, Yildiz B, Cakmak I. Improved nitrogen nutrition enhances root uptake, root-to-shoot translocation and remobilization of zinc (Zn) in wheat. New Phytologist. 2011; 189:438-448.
12. FAO/WHO. Expert Consulation on Human Vitamin and Mineral Requirements, Vitamin and mineral requirements in human nutrition: report of joint FAO/WHO expert consolation, 2nd edition. Bangkok, Thailand, 2004, 341.
13. Grotz N, Guerinot ML. Molecular aspects of Cu, Fe and Zn homeostasis in plants. Biochem. Biophys. Acta. 2006; 17:595-608.
14. Hacisalihoglu G, Kochian LV. How do some plants tolerate low levels of soil zinc, Mechanisms of zinc efficiency in crop plants. New Phytolo. 2003; 159:341-350.
15. Houben D, Sonnet P. Zinc mineral weathering as affected by plant roots. Applied Geochem. 2012; 27:1587-1592.
16. Keram KS, Sharma BL, Sharma GD, Thakur RK. Impact of zinc application on its translocation into various plant parts of wheat in a vertisol. J Soil Sci. and Agri. Chem. 2014; 9(2):491-495.
17. Khalid N, paigham S, Arif M, Azim MK, Mateen A, Fazal M, Kawsar A. Effect of cropping patterns, farm yard manure, K and Zn of wheat growth and grain yield. Sarhad J Agri. 2011, 2011, 27(3).
18. Khan MA, Fuller MP, Baluch FS. Effect of soil applied zinc sulphate on wheat (*Triticum aestivum* L.) grown on a calcareous soil in Pakistan. Cereal Research Communi. 2008; 36(4):571-582.
19. Khan MB, Farooq M, Hussain M, Shahnawaz, Shabir G. Foliar application of micronutrients improves the wheat yield and net Economic return. Int. J Agric. Biol. 2010; 12:953-956.
20. Lombnas P, Singh BR. Varietal tolerance to zinc deficiency in wheat and barley grown in chelator-buffered nutrient solution and its effect on uptake of Cu, Fe, and Mn. J Plant Nutr. and Soil Sci. 2003; 166(1):76-83.
21. Maqsood MA, Ullah R, Kanwal S, Aziz T, Ashraf M. Evaluation of Zn distribution among grain and straw of twelve indigenous wheat (*Triticum aestivum* L.) genotypes. Pak. J Bot. 2009; 41(1):225-231.
22. Masoud B, Abdolshahi R, Nejad GM, Yousefi K, Tabatabaie SM. Effect of different microelement treatment on wheat (*Triticum aestivum* L.) growth and yield. Inter. Research J Applied Basic Sci. 2012; 3(1):219-223.
23. Ondrasek G, Rengel Z. The Role of Soil Organic Matter in Trace Element Bioavailability and Toxicity, 2012, 403-423.
24. Phattarakul N, Kang BS, Surek H, Kalayci M, Yazici A, Zhang FS, *et al*. Bio fortification of rice grain with zinc through zinc fertilization in different countries. Plant Soil. 2012; 361:131-141.
25. Rahimi A, Rezaei S, Nouri H, Aghashiri A. Effects of municipal wastewater and zinc fertilizer on yield and yield components of wheat (*Triticum aestivum L.*) in the Yasouj region of Iran. Int. J Agric. Sci. 2012; 2:313-319.
26. Shewry PR. Wheat. J Experi. Bot. 2009; 60:1537-1553.
27. White PJ, Broadley MR. Physiological limits to zinc biofortification of edible crops. Frontiers in Plant Science. 2011; 2:80.
28. Yaseen M, Ahmed W, Arshad M, Ali Q. Response of wheat (*Triticum aestivum L.*) to foliar feeding of micronutrients. Int. J Agro Veterinary Medical Sci. 2011; 5:209-220.
29. Yassen A, Abou El-Nour EAA, Shedeed S. Response of wheat to foliar spray with urea and micronutrients. J Am. Sci. 2010; 6:14-22.