Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(5): 503-505
Received: 07-07-2019
Accepted: 09-08-2019

Subhashisa Praharaj
PhD Scholar, Department of Agronomy, GBPUAT, Pantnagar, Uttarakhand, India

Rohitashav Singh
Professor, Department of Agronomy, GBPUAT, Pantnagar, Uttarakhand, India

VK Singh
Professor, Department of Agronomy, GBPUAT, Pantnagar, Uttarakhand, India

Ramesh Chandra
Professor, Department of Soli Science, GBPUAT, Pantnagar

SK Guru
Professor, Department Plant Physiology, GBPUAT, Pantnagar, Uttarakhand, India

Sumit Chaturvedi
Associate Professor, Department of Agronomy, GBPUAT, Pantnagar, Uttarakhand, India

Correspondence
Subhashisa Praharaj
PhD Scholar, Department of Agronomy, GBPUAT, Pantnagar, Uttarakhand, India

Yield and grain zinc concentration of wheat as affected by nutri priming and foliar application of zinc

Subhashisa Praharaj, Rohitashav Singh, VK Singh, Ramesh Chandra, SK Guru and Sumit Chaturvedi

Abstract
Two pot experiments were conducted during 2017-18 to see the effects of nutri priming of seeds with zinc solution and foliar application of zinc (alone and in combination with urea) on yield and grain zinc concentration of bread wheat. The results suggested that nutri priming of seeds with different concentrations (0.1%, 0.3%, 0.5% and 0.7%) of zinc sulphate heptahydrate solution could not improve yield over control. However, grain zinc concentration was significantly higher over control in all the nutri priming treatments, though there was no significant difference in grain zinc concentration among these nutri priming treatments. Foliar application of zinc significantly improved grain zinc concentration of wheat. Addition of urea at 0.5% and 1% to the spray solution could not bring significant improvement in grain zinc concentration over the application of zinc sulphate heptahydrate alone.

Keywords: Agronomic biofortification, foliar, nutri priming, wheat, zinc sulphate heptahydrate.

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important cereal crops grown in India. Wheat covers around 30.05 million ha of land with a production of 98.61 mt (IIWBR annual report, 2017-18) [7]. Wheat holds a great significance in ensuring food security. Zinc deficiency often limits the productivity of cereals, though the response to the nutrient varies with crop (Rattan *et al*., 2008) [11].

Zinc is an important part of enzymes like carbonic anhydrase, superoxide dismutase, alcohol dehydrogenase and RNA polymerase as well as cofactor of all six classes of enzymes i.e. hydrolases, ligages, lysases, isomerase, oxidoreductases and tranferases (Broadley *et al.*, 2007, Maret, 2013) [2, 10]. Considering these important roles played by zinc in plant growth and development, management of zinc is very much crucial to enhance grain yield.

In addition to yield enhancement application of zinc to wheat has also been effective in enhancing grain zinc concentration. As zinc plays an important role in human physiology and metabolism, in addition to enhancement in grain yield, zinc management for enhancing grain zinc concentration also holds great significance. Among micronutrient deficiency, zinc deficiency may cause some significant problem which includes impairment in physical growth, sensory function, immunity system and poor birth outcomes (Hambidge 2000; Kennedy *et al*., 2003; Fraga, 2005; Wei *et al.*, 2012) [6, 8, 5, 12].

Use of zinc fertilizer for enhancing grain zinc concentration (called agronomic biofortification) can play an important role in enhancing grain zinc concentration and thus, minimize the micronutrient deficiency in human body. Zinc can be applied to crop through different application methods like soil application, foliar application or through seed priming. However different application methods show different response in improving grain zinc concentration.

Among application methods foliar application has been found to be very effective in enhancing grain zinc concentration (Cakmak, 2010; Zou *et al*., 2012) [3, 13]. In addition to foliar application seed priming has also been studied by many researchers for its potential to improve productivity and grain zinc concentration of wheat (Farooq *et al*., 2012) [4].

Considering this, two pot experiments were planned to see the effect of seed priming with Zinc sulphate heptahydrate solution of different concentration and the effect of foliar application of zinc sulphate heptahydrate and its combination with urea on yield and grain zinc concentration of wheat.

Material and methods

Two pot experiments were conducted during Rabi, 2017-18. For both pot experiments, ten seeds of variety UP 2784 were sown in each plastic pots containing 5 kg soil. 4 plants were maintained up to harvest. Soil used in the pot experiments had 0.60 mg/kg zincas determined by DTPA extraction method (Lindsay and Norvell 1978) [9].

After maturity, grainswere harvested separately from each pot. Grain was collected by threshing manually. Zinc in the grain sample was estimated with AAS. Grain sample was digested using diacid digestion mixture of HNO_3 and $HClO_4$ (in 9:4). Grain yield was calculated on per plant basis.

Both the experiments consisted of 6 treatments and 3 replications and conducted in a completely randomized design. The data from the experiment were analyzed using STPR statistical software.

Treatment details of both pot experiments are as below.

Pot experiment 1: Effect of different concentration of priming solution on yield and grain zinc concentration of wheat

The experiment consisted of 6 treatments *i.e.* T_1: Control (no priming), T_2: Hydropriming, T_3: Nutripriming with 0.1% $ZnSO_4$. $7H_2O$, T_4: Nutripriming with 0.3% $ZnSO_4$. $7H_2O$, T_5: Nutripriming with 0.5% $ZnSO_4.7H_2O$ and T_6: Nutripriming with 0.7% $ZnSO_4.7H_2O$.

For seed priming experiment priming was done with 4 different concentrations of zinc sulphate heptahydrate (i.e. 0.1%, 0.3%, 0.5% and 0.7%) for 6 hours and seeds were shade dried before sowing. For hydro priming treatment, seeds were primed with water without adding zinc.

Pot experiment 2: Effect of foliar application of $ZnSO_4$. $7H_2O$ and its combination with urea on yield and grain zinc concentration of wheat

The experiment consisted of sixtreatments. T_1: Control (No zinc), T_2: Foliar application of 0.5% urea, T_3: Foliar application of 1% urea, T_4: Foliar application of 0.5% $ZnSO_4.7H_2O$, T_5: Foliar application of 0.5% $ZnSO_4.7H_2O$+ 0.5% Urea, T_6: Foliar application of 0.5% $ZnSO_4.7H_2O$ + 1% Urea.

Foliar application was done in the late afternoon. Spraying using a hand sprayer was continued to completely wet the foliage while avoiding runoff. Foliar application was done at heading and early milk stage of the plants.

Results and discussion

Pot experiment 1: Seeds were primed with four different concentrations (0.1%, 0.3%, 0.5% and 0.7%) of $ZnSO_4$. $7H_2O$ solutions for 6 hours. Nutri primed seeds were compared against no priming (control) and hydro priming. The data related to yield suggests no significant variation in yield across treatments. Though numerical decrease in grain yield was observed with increase in the concentration of priming solution beyond 0.3%, however such difference was statistically insignificant.

In terms of zinc concentration in grain, all nutri priming treatments (where seeds were primed with 0.1%, 0.3%, 0.5% and 0.7% zinc sulphate heptahydrate solution) could significantly improve grain zinc concentration above control, however hydro primed seeds failed to do so. The increase in zinc concentration due to nutri priming was very nominal. At 0.7% a small reduction in grain zinc concentration was observed (though statistically at par with 0.1%, 0.3% and 0.5 % priming solution).

The increase in grain zinc concentration might be due to better zinc supply to the seedlings. Improvement of micronutrient concentration in grain due to seed priming with micronutrient solution has also been reported by Farooq *et al*. (2012) [4] When plants are provided with zinc then partitioning or translocation of zinc towards grain might have improved the grain zinc concentration. In the present experiment no significant improvement in grain yield was observed, this might be due to very low amount of zinc supplied to the plant through nutria priming.

Pot experiment 2: Application of 0.5% $ZnSO_4.7H_2O$ significantly improved grain zinc concentration (Table 2). Grain zinc concentration in the treatment (i.e. foliar application of 0.5% $ZnSO_4.7H_2O$) was 41.27 mg/kg while in control, the grain zinc concentration was 23.20 mg/kg.

Foliar application of 0.5% and 1% urea had could not improve grain zinc concentration over control. Addition of urea (0.5% or 1%) to 0.5% $ZnSO_4.7H_2O$ spray solution further enhanced grain zinc concentration. Application of 0.5% urea along with 0.5% zinc sulphate increased the grain zinc concentration nominally over the application of 0.5% zinc sulphate alone, however such increase was statistically non-significant. Similarly, Application of 1% urea along with 0.5% zinc sulphate further increased the grain zinc concentration above the application of 0.5% zinc sulphate alone however; such increase in concentration was statistically insignificant.

No significant improvement in grain yield might be due to late application of zinc (foliar application of zinc was done at heading and early milk stage).

Improvement in grain zinc concentration due to foliar application of zinc has also been reported by Zou *et al.* (2012) [13] Improvement in the grain iron concentration in wheat due to addition of urea to Fe fertilizers has been reported by Aciksoz *et al.* (2011) [1]. It is believed that urea facilitates the cuticular penetration of foliar sprayed ions (Aciksoz *et al*., 2011) [1]. Though the increase in grain zinc concentration due to addition of urea to zinc sulphate was not significant however, such positive effect must be studied on field scale to test their efficiency in further improving grain zinc concentration.

Table 1: Effect of different concentration of priming solution on grain zinc concentration and yield of wheat

Treatments	Yield (g/plant)	Grain zinc concentration (mg/kg)
Control	1.85	22.87
Hydro priming	1.86	22.93
Nutri priming @ 0.1% $ZnSO_4.7H_2O$	1.85	25.77
Nutri priming @ 0.3% $ZnSO_4.7H_2O$	1.90	25.93
Nutri priming @ 0.5% $ZnSO_4.7H_2O$	1.86	25.97
Nutri priming @ 0.7% $ZnSO_4.7H_2O$	1.82	25.80
S.Em±	0.02	0.72
CD(P=0.05)	NS	2.20

Table 2: Yield and grain zinc concentration of wheat as affected by foliar application of $ZnSO_4$. $7H_2O$ and its combination with urea

Treatments	Yield (g/plant)	Grain zinc concentration (mg/kg)
Control	1.83	23.20
0.5%Urea	1.84	24.07
1%Urea	1.84	23.20
0.5% $ZnSO_4.7H_2O$	1.85	41.27
0.5% $ZnSO_4.7H_2O$ +0.5%Urea	1.87	43.63
0.5% $ZnSO_4.7H_2O$+ 1% Urea	1.86	44.03
S.Em±	0.02	0.97
CD(P=0.05)	NS	2.99

Conclusion: Both nutri priming and foliar application of zinc are effective in improving grain zinc concentration of wheat; however, no significant improvement in yield was observed in both application methods.

Acknowledgement: The financial assistance provided by DST; New Delhi is acknowledged.

References

1. Aciksoz SB, Yazici A, Ozturk L, Cakmak I. Biofortification of wheat with iron through soil and foliar application of nitrogen and iron fertilizer. Plant and soil 2011; 349:215-225.
2. Broadley MR, White PJ, Hammond JP, Zelko I, Lux A. Zinc in plants. The New Phytologist. 2007; 173(4):677-702.
3. Cakmak I, Pfeiffer WH, McClafferty B. Biofortification of durum wheat with zinc and iron. Cereal Chemistry. 2010; 87(1):10-20.
4. Farooq M, Wahid A, Siddique KH. Micronutrient application through seed treatments: a review. Journal of soil science and plant nutrition. 2012; 12(1):125-142.
5. Fraga CG. Relevance, essentiality and toxicity of trace elements in human health. Molecular aspects of medicine. 2005; 26(4-5):235-244.
6. Hambidge M. Human zinc deficiency. The Journal of nutrition. 2000; 130(5):1344-1349.
7. IIWBR annual report, 2017-18.
8. Kennedy G, Nantel G, Shetty P. The scourge of hidden hunger: global dimensions of micronutrient deficiencies. Food Nutrition and Agriculture. 2003; 32:8-16.
9. Lindsay WL, Norvell WA. Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil science society of America journal. 1978; 42(3):421-428.
10. Maret W. Zinc biochemistry: from a single zinc enzyme to a key element of life. Advances in nutrition. 2013; 4(1):82-91.
11. Rattan RK, Datta SP, Katyal JC. Micronutrient managements- research achievements and future challenges. Indian journal of fertilizers. 2008; 4(12):93-118.
12. Wei Y, Shohag MJI, Yang X. Biofortification and bioavailability of rice grain zinc as affected by different forms of foliar zinc fertilization. *PloS one*. 2012; 7(9):45428.
13. Zou CQ, Zhang YQ, Rashid A, Ram H, Savasli E, Arisoy RZ *et al*. Biofortification of wheat with zinc through zinc fertilization in seven countries. Plant and soil. 2012; 361(1-2):119-130.