Effect of seed priming with Zn, Mn and B in different concentrations on yield and yield components of wheat (*Triticum Durum*)

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**Abstract**

To evaluate the effect of different concentrations of seed priming performed one experiment as Factorial design on the basis of CRD with three replications on yield of Durum wheat and its components in Tabriz University (Agricultural Branch) during growing season of 2012. Treatments were four levels of priming (ZnSO₄, MnSO₄·H₂O, H₃BO₃ and water) and three different concentrations (0/001, 0/003 and 0/005 mg/kh⁻¹). Analysis of data revealed that using of nutritious showed that height of plant, number of node, dry weight of leaves and 100-grain, also yield of grain increased significantly by 1%. Furthermore, the effect of the different concentrations caused that the dry weight of the leaves and 100-grain, the yield of the grain by 1% and the number of the node had significantly effect by 5%.

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Introduction
Durum wheat was first produced in Australia in the early 1930s (Kneipp, 2008). Nowadays, North Dakota is the largest durum producer in the United States (Elias, 2004). But, Crop productivity like wheat in developing world faces several constraints. One of the major crop productivity constraints in the world is the unavailability of nutrients in appropriate amount and form to crops. Among the factors responsible for low yield are high weed infestations, imbalance use of fertilizers, improper plant protection cover and sub optimum plant population. Sub optimum plant population generally results from poor and erratic germination (Hussain et al., 2006). Multiple micronutrient deficiencies (Zn, Mn and B) occur in soils of the Iran and are becoming more prevalent as cropping intensity increases (Malakouti et al., 2009). However, most of Iranian soils are deficient in these nutrients, and must be supplemented through proper crop nutrients management (Harris et al., 2007).

There are three main methods of adding micronutrients to crops: soil fertilization, foliar sprays and seed treatment. Each method has the potential to affect plant micronutrient nutrition both in the treated plant directly and in the progeny plants through enrichment of the seeds by micronutrient treatment of the parent. Foliar applications of micronutrient sprays have been effective towards both goals (Wilhelm et al., 1988 and Savithri et al., 1999), but this method is too expensive to be widely practiced by resource-poor farmers in some regions because of the amount of fertilizer, equipment and labor required for repeated spraying. Likewise, the difficulty in obtaining high quality micronutrient fertilizers and spreading them evenly on the soil can be prohibitive.

Treating seeds with micronutrients potentially provides a simple inexpensive method for improving micronutrient plant nutrition. Farmers in South Asia have responded favorably to seed priming, a simple technology of soaking seeds overnight in water prior to sowing (Harris, 1997 and Harris et al., 1999). Using enriched seeds by micronutrient priming is found to be as a better strategy for overcoming micronutrient deficiencies (Harris et al., 2007). Seed priming has been shown to enhance seed germination speed (Ryan and Young, 2006), decrease time between sowing and emergence and improve seedling vigor and better stand establishment (Ali et al., 2007 and Arif et al., 2005) and increasing yield (Yilmaz et al., 1998). Also, priming seeds in solutions micronutrients has been shown to improve yield in several plants such as wheat (Khalid and Malik, 1982; Marcar and Graham, 1986 and Wilhelm et al, 1988).

In recent years, a lot of work has been done on the invigoration of seeds to improve the germination rate and uniformity of growth and reduce the emergence time of some field crops (Basra et al., 2003). In case of umbel number per plant of dill, the effect of seed treatments was highly significant. Treatments with dilute concentrations of Zn and Mn gave a significant increase over control (Mirshekari, 2010). Manganese is an essential trace nutrient in all known forms of life (Emsley, 2001). Manganese is the other nutrients which is important in nitrogen metabolism and photosynthesis (Stout and Arnon, 1939). Seed priming with manganese also improves seedling establishment (Farooq et al., 2012). In wheat seed priming with manganese significantly improves growth rate and grain yield (Khalid and Malik, 1982). Also, Boron is important for cell division elongation, translocation and cell wall development (Iqbal et al., 2012).

The purpose of this study was effect of seed priming with Zn, Mn and B in Different Concentrations on Yield and Yield Components of Wheat. Under this conditions, we tried to know seed priming of best stage and changeable important characteristic.

Materials and methods
A factorial experiment based on CRD design with three replications was conducted during growing season of 2012 at Tabriz University, the faculty of Agriculture which was located in the North West of Iran. Treatments consisted of four levels (ZnSO₄, MnSO₄, H₂O, H₃BO₃ and water) of seed priming (SP)
as main factor and three different concentrations (0.001, 0.003 and 0.005 mgkg⁻¹) as the second factor. Each plot consisted of 5 rows with 15 cm apart and 4 cm apart on the row, also 3.5 m long and with the width of 3 m. Seeds were placed in to soil in the depth of 4 cm. Planting did the end of May. According to the results of the soil analysis, 300 kg.ha⁻¹ urea, 150 kg.ha⁻¹ triple super phosphate and 100 kg.ha⁻¹ potassium sulfate were applied to the soil as the starter fertilizer prior. Furthermore, thinning and weeding were performed. Seed priming in different concentrations and the varied kind of levels of priming did on Durum wheat. Seed priming performed before the planting during 24 hours. Plant height, leaf dry weight, number of node, 100-grain weight and yield of grain were measured. MSTATC and Excel were used to analyze data and draw graphs.

**Results and discussion**

*Plant Height*

Analysis of variance revealed that use of SP and interaction effect of SP by different concentrations of the micro-nutrients on plant height affected significantly at 1% level of probabilities (table 1). The highest and lowest height produced 40/60 and 20/42 cm with 3 mgkg⁻¹ of WSP and 1 mgkg⁻¹ of BSP, respectively. But, it wasn't observed differences which are related to MnSP with 1, 5 and 3 mgkg⁻¹.

Moreover, ZnSP with 5 and 1 mgkg⁻¹ had slight rise by 14/81% and 14/58% in compare with 3 mg.kg⁻¹ concentration of its. BSP had not difference together in 3 concentrations, too (fig 1).

### Table 1. Analysis of variance of surveyed attributes of Durum Wheat.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>S.O.V.</th>
<th>df</th>
<th>Plant Height</th>
<th>Leaf Dry Weight</th>
<th>Number of Node</th>
<th>100-Grains Yield</th>
<th>Grain Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3</td>
<td>19487</td>
<td>0.147**</td>
<td>27.803**</td>
<td>0.147**</td>
<td>1345.810**</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>1212</td>
<td>0.004&quot;</td>
<td>0.397&quot;</td>
<td>0.778&quot;</td>
<td>63.513&quot;</td>
<td></td>
</tr>
<tr>
<td>AB</td>
<td>6</td>
<td>20.867</td>
<td>0.002&quot;</td>
<td>0.135&quot;</td>
<td>0.399&quot;</td>
<td>29.494&quot;</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>24</td>
<td>27.92</td>
<td>0.003</td>
<td>0.116</td>
<td>0.065</td>
<td>5.709</td>
<td></td>
</tr>
<tr>
<td>(CV%)</td>
<td>6.50</td>
<td>11.44</td>
<td>12.93</td>
<td>11.22</td>
<td>13.05</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS, * and ** non-significant, significant 5% and 1% respectively

A: factors of priming
B: concentration of nutritious.

### Table 2. Effect of seed priming in different concentrations on Durum Wheat attributes.

<table>
<thead>
<tr>
<th>SP</th>
<th>Plant Height</th>
<th>Leaf Dry Weight</th>
<th>100-Grains Weight (g)</th>
<th>Grain Yield (g.m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a, b₁</td>
<td>40.60</td>
<td>A</td>
<td>0.2467</td>
<td>A</td>
</tr>
<tr>
<td>a, b₂</td>
<td>34.19</td>
<td>BC</td>
<td>0.2033</td>
<td>A</td>
</tr>
<tr>
<td>a, b₃</td>
<td>34.02</td>
<td>BC</td>
<td>0.2500</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>26.95</td>
<td>D</td>
<td>0.2300</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>30.88</td>
<td>C</td>
<td>0.2400</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>30.94</td>
<td>C</td>
<td>0.2367</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>34.66</td>
<td>BC</td>
<td>0.2500</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>34.92</td>
<td>BC</td>
<td>0.2567</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>37.21</td>
<td>AB</td>
<td>0.3467</td>
<td>A</td>
</tr>
<tr>
<td>a₁</td>
<td>23.71</td>
<td>E</td>
<td>0.1800</td>
<td>B</td>
</tr>
<tr>
<td>a₁</td>
<td>22.07</td>
<td>E</td>
<td>0.1723</td>
<td>B</td>
</tr>
<tr>
<td>a₁</td>
<td>20.42</td>
<td>EF</td>
<td>0.1584</td>
<td>B</td>
</tr>
</tbody>
</table>

WSP with 3 mg.kg⁻¹ concentration as the highest amount of height increased by 9/11%, 16/27% and 17/14% in contrast with MnSP with 1, 5 and 3 mgkg⁻¹, respectively. But, it wasn't observed differences which are related to MnSP with 5 and 3 mgkg⁻¹.
WSP had performed during 17 hours that it had some influences on germination of corn. Researchers noticed this activity escalated the height of the corn (Mir-Hashemi et al., 2010). In the other research, the growth parameters of chickpea had significantly affected by seed priming. The observations were recorded on height of chickpea. It was significantly affected by seed priming [Vikas and Mahender, 2012].

Table 3. Analysis of Number of Nodes on Durum Wheat.

<table>
<thead>
<tr>
<th>Durum Wheat</th>
<th>Number of Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>a: Zn</td>
<td>3.393 A</td>
</tr>
<tr>
<td>a2: Mn</td>
<td>3.444 A</td>
</tr>
<tr>
<td>a3: B</td>
<td>3.681 A</td>
</tr>
<tr>
<td>a4: W</td>
<td>2.725 A</td>
</tr>
</tbody>
</table>

Leaf Dry Weight
It was noticed that different concentrations and varied kind of SP and interaction effect of both of them in leaf dry weight (g) affected significantly at %1 level of probabilities (table 1). The maximum and minimum leaf dry weight were 0/2467 g in MnSP with 1 mgkg⁻¹ and 0/1584 g in BSP with 5 mgkg⁻¹ concentrations that BSP was 118/88% less than MnSP (table 2).

Table 4. Analysis of Number of Nodes on Durum Wheat.

<table>
<thead>
<tr>
<th>Durum Wheat</th>
<th>Number of Node</th>
</tr>
</thead>
<tbody>
<tr>
<td>b1, 0.003</td>
<td>2.422 A</td>
</tr>
<tr>
<td>b2, 0.005</td>
<td>2.709 A</td>
</tr>
<tr>
<td>b3, 0.001</td>
<td>2.758 A</td>
</tr>
</tbody>
</table>

Number of Node
Analysis of data showed different levels of priming and their concentrations in number of node affected significantly at %1 and 5% probabilities. The mutual effect of these characters had not significant probabilities (table 1).

Applying of ZnSP and MnSP in compare with WSP had slow surge by 1/50% and 8/49% (table 3) and (fig 4). Also, any of the concentrations which were related to the nutritious didn't have significant effect on number of node (table 4) and (fig 3).

The result of one experiment confirmed that priming of rice seed with Zn can improve germination and seedling vigor and for the first time show how Zn requirement of germinating rice seed and seedlings can be met by the prime Zn accumulated in the husk (Prom-u-thai and et al., 2012). According to the research on rice, seed priming had significant effect on number of tillers (Binang et al., 2012).

100-Grains Weight
Analysis of data illustrated that application of different concentrations, factors of SP and mutual...
effect of them affected significantly at %1 level of probabilities (table 1). The maximum and minimum 100-grains weight produced by $3/673$ g in WSP with $3 \text{ mgkg}^{-1}$ and $1/005$ g in BSP with $3 \text{ mgkg}^{-1}$ that BSP was $72/64\%$ less than WSP (table 2).

Values of WSP by $3 \text{ mgkg}^{-1}$ compared with ZnSP by $1 \text{ mgkg}^{-1}$ and MnSP by $3 \text{ mgkg}^{-1}$ that had $8/03\%$ and $9/32\%$ increase. ZnSP with $1 \text{ mgkg}^{-1}$ had a gradually upsurge in contrast with $3$ and $5 \text{ mgkg}^{-1}$ of concentrations of its that were about $12/77\%$ and $21/43\%$. However, MnSP had the high amount of 100-grains weight in $3 \text{ mgkg}^{-1}$ concentration that in ratio to $5$ and $1 \text{ mgkg}^{-1}$ of its had slow surge around $25/98\%$ and $40\%$. BSP with $1 \text{ mgkg}^{-1}$ relative to $5$ and $3 \text{ mgkg}^{-1}$ had approximately increased by $35/4\%$ and $39/30\%$ (fig 5).

**Grain Yield**

Analysis of data revealed that different factors of SP, their concentrations and interaction effect of them on grain yield affected significantly at %1 level of probabilities (table 1). The maximum yield and minimum of its produced in WSP with $1 \text{ mgkg}^{-1}$ and BSP with $5 \text{ mgkg}^{-1}$ concentrations by $30/40$ and $14.01 \text{ gm}^{-2}$ that BSP was $53/91\%$ less than WSP (table 2).

An increased value of WSP with $1 \text{ mgkg}^{-1}$ concentration was found to be $8/96\%$ and $7/65\%$ as compared with MnSP and ZnSP. Then, ZnSP with $1 \text{ mgkg}^{-1}$ concentration was more than $13/28\%$ and $28/36\%$ regard to $3$ and $5 \text{ mgkg}^{-1}$ of its. It follows that MnSP with $3 \text{ mgkg}^{-1}$ had gentle pick about $26/82\%$ and $31/98\%$ in contrast with $5$ and $1 \text{ mgkg}^{-1}$ of its. BSP with $3 \text{ mgkg}^{-1}$ in ratio to $1$ and $5 \text{ mgkg}^{-1}$ shot up gently $21/22\%$ and $27/62\%$ (fig 6).
Fig. 5. Seed priming with Zn, Mn, B and water in different concentrations on weight of 100-grains.

Fig. 6. Seed priming with Zn, Mn, B and water in different concentrations on yield of grain.

Effect of priming in field and data of planting performed on 3 species of soybean in 2009. M_9 had the high amount of the yield, when it used water priming and in compare with the control showed a rise about 35% (Rah-Chamani et al., 2009). Then in that case, it can be seen the same result of the priming on yield and yield components of Chickpea. It means that the water priming took off the grain yield in 5% probabilities (Shamchi-Rezaiyeh et al., 2010). Kant and his colleagues (2006) reported that seed priming improves stand establishment, growth and yield of late sown wheat in rice-wheat systems. Harris and colleagues (2001) reported that the direct benefits of seed priming in all crops included faster emergence, better, more and uniform stands, less need to re sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. Also, the effect of seed priming and micro-dosing in groundnut, cowpea and sesame was studied for three years in on-farm and on station experiments in North Kordofan, Sudan. Priming alone did not significantly affect sesame seed or hay yield, but micro-dosing of 0.6 g per pocket increased the grain yield by 38% over the control. These results show that the combination of micro-dosing and seed priming has the potential to take up productivity and improve net return in the crops tested (Ousman and Aune, 2011).

Conclusion
Results obtained from this research illustrated Seed priming with Zn, Mn, B and water in different concentrations had different effect on yield and different parts of yield of Durum wheat. WSP with 3 mgkg\(^{-1}\) in compare with the other treatments was high. The maximum height, weight of 100-grains and grain yield were in 3 mgkh\(^{-1}\) of WSP and moreover, leaf dry weight was in MnSP with 1 mgkg\(^{-1}\). On average, WSP with 3 mgkg\(^{-1}\) concentration increased grain yield of Durum wheat approximately about 31/73%, totally.

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Abbreviation. CRD- complete randomize design, SP- seed priming, BSP- H\(_2\)BO\(_3\) seed priming, MnSP- MnSO\(_4\) seed priming, ZnSP- ZnSO\(_4\) seed priming.

References


Basra SMA, Zia MN, Mehmood T, Afzal I,

http://dx.doi:10.3923/rjss.2012.136.143


http://dx.doi.org/10.1016/j.fcr.2007.03.005

http://dx.doi.org/10.1017/S0014479799001027


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