

Effect of Wheat Grains Soaking in Micro-element Solutions on Yield and its Components

Nadia M. Mahmoud ; E.A. Teama ; A.M. Abou-Salama and Anaam H. Galal

¹ Agronomy Department, Faculty of Agriculture, Assiut University

Abstract:

This investigation was carried out in the Agricultural Experimental Farm at Fac. Agric., Assiut Univ., during the two winter growing seasons 2009/2010 and 2010/2011 to study the effect of wheat grains soaking in micro-element solutions on yield and its components. The used experimental design was a Randomized Complete Block Design in split-plot with four replications. Wheat varieties (Giza 168 and Bani-Swef 1) were allocated in the main plot, while micronutrient treatments (Fe, Zn, Mn, Fe+Mn, Zn+Mn, Fe+Zn and Fe+Mn+Zn) were distributed in the sub-plot. The plot area was 3x3.5 m². The results could be summarized as follows:

- Giza 168 variety surpassed and gave significant increase in the spike length, 1000-grains weight and straw yield in both seasons, as well as in the first season only gave significant increase in number of spikelets/spike and number of spikes/m² over Bani-Swef 1.
- The maximum values for plant height, spike length, 1000-grains weight, number of spikelets/spike, number of spikes/m², grain yield/fed., straw yield/fed. were recorded by Fe+Mn+Zn treatment in both seasons.
- The interaction between varieties and micronutrient treatments had non-significant effect on the all studied traits in both seasons.

Keywords: Soaking, micro-element, solution.

Received on: 16 /11 / 2014

Accepted for publication on: 30/11/2014

Referees: Prof. Ragab A. E. Dawood

Prof. Eman M. Taha

Introduction:

In Egypt, wheat has been considered to be the first strategic cereal crop for making bread as well as the wheat straw is important for hay feeding. Therefore, it is the first food crop in Egypt and the whole world. Wheat occupied an area estimated at about 3.6 million fed. with total production 8.28 million ton with average grain yield 18.00 ardab/fed. (FAO, 2013). However, this production did not meet consumption party due to crop leakage for other misused as well as the over growing population and hence consumption.

Zinc is micronutrient required in traces for normal plant growth, zinc plays essential metabolic roles in plant and works as regulatory co-factor for several enzymes. It is very closely involved in N metabolism of the plant. In levels are markedly zinc deficient plants protein synthesis, protein reduced, and amino acids and amides are accumulated. Iron is involved in the production of chlorophyll and iron chlorosis is easily recognized on iron sensitive crops growing calcareous soils. Iron also a component of many enzymes associated with energy transfer, nitrogen reduction and fixation, and lignin formation. Manganese is necessary in photosynthesis, nitrogen metabolism to form other compounds required for plant metabolism. Few reports examined the effect of grains soaking in micronutrients on maize uptake of nitrogen.

Harb (1992) used seed soaking of faba bean and cotton with micronutrients or growth regulator. He reported that the treatment led to an increase in seed yield. Zhang *et al.* (1992) reported that seed treatment of maize and rice with zinc sulphate in-

creased zinc uptake in both crops. Furthermore, they reported that yield increases in rice due to soaking. Jeyabal and Kuppaswamy (1998), found that seed soaking with zinc along with other organic biofertilizers improved rice seedling characteristics. Nitrogen uptake improved by up to 11.8% in early seedling age (30 days) growth and yield attributes increased due to seed soaking. Grain yield increased by 8.8% over unsoaked seeds. Saad *et al.* (1999) studied small cereal soaking with zinc sulphate; they found that 0.01% zinc sulphate increased grain yield of wheat, barley and triticale.

Brennan (2001) observed that applied zinc fertilizers increased wheat dry matter, zinc content of the dry matter and grain yields. In nutrient priming, seeds are pretreated (primed) in solutions containing the limiting nutrients instead of being soaking simply in water (Arif *et al.*, 2005). Iron (Fe), zinc (Zn), manganese (Mn) are essential micronutrients for plant and humans (Kaya *et al.*, 1999; Asad and Rafique, 2000). Hao *et al.* (2007) reported that a deficiency of just one of these nutrients can greatly reduce plant yield and even cause plant death. Micronutrient deficiency, especially Fe and Zn deficiency, is widespread in humans (Graham *et al.*, 1999; Stoltzfus, 2001 and Liu *et al.*, 2006). Crop management strategies are an important complement to on going breeding programs. Studies have shown that Fe, Zn, Cu and Mn concentration in rice or wheat grain can be increased by proper irrigation management, N fertilization, and late planting (Hao *et al.*, 2007 and Pearson *et al.*, 2008). A number of studies have reported that the application of micronutrient ferti-

lizers to the soil or crop foliage increased micronutrient concentrations in grain. However, some authors found that foliar sprays resulted in nutritional disorders and imbalances (Ghasemi-Fassaei and Ronaghi, 2008; Pahlavan-Rael and Pessaraki, 2009).

The effects of soaking whole cereal (rice, maize, sorghum) and legume seeds (mung bean, cow pea, soybean) on iron (Fe), zinc (Zn) contents were investigated. In all the above cereals, except millet, the molar ratios of Phy/Fe were above 20, while, in legumes, ration were lower. Soaking whole seeds for 24 h led to leaching of iron and to a lesser extent,

of zinc ions into the soaking medium. This work aimed to investigate the effect of wheat grains soaking in micro-element solutions on the yield and its components.

Materials and Methods:

This work was carried out at the Experimental Farm of the Faculty of Agriculture, Assiut University, during the two winter growing seasons 2009/2010 and 2010/2011, to study the effect of wheat grains soaking in micro-element solutions on yield and its components. The soil of the experimental site was clay. The main properties of the soil are given in Table (1).

Table 1: Average of the main properties of the experimental soil in 2009/2010 and 2010/2011 seasons.

Soil properties	values	
	2009/2010	2010/2011
Analysis:		
Sand %	26.6	27.2
Silt %	25.2	22.3
Clay %	48.8	48.4
Texture	Clay	Clay
E.C. (%)	42.0	41.0
Organic matter	1.80	2.0
pH	7.8	7.9
Available P (ppm)	9.0	10.0
Available Fe (ppm)	129.0	128.0
Available Mn (ppm)	24.2	25.4
Available Zn (ppm)	20.7	21.8
Total N %	0.08	0.081

The used experiment design was a Randomized Complete Block Design in split-plot arrangement of treatments with four replications. Wheat varieties (Giza 168 and Bani-Swef 1) were allocated in the main plots, while micro-element solutions were randomly distributed in the sub-plots.

The experiment was planted on the 26 November in both seasons. The area of each plot was 3x3.5 m² in

each season. Wheat grains were soaked for 24 hours before planting in one of the seven different solutions along with a control treatment of distilled water. The solutions contained 100 ppm of either; MnSO₄.H₂O, FeSO₄.7H₂O, ZnSO₄.7H₂O as single compound or their combinations of the above micronutrients as two elements mixture for Fe and Zn, Zn and Mn and Fe and Mn as well as three elements mixture for Fe, Mn and Zn.

The seeding rate were 60 kg/fed. in Giza 168 and 70 kg/fed. in Bani-Swef 1. recommended rates of 70 kg nitrogen was applied as ammonium nitrate (33.5% N) and 31 kg phosphorus was applied as a single super-phosphate (15.5% P₂O₅) during soil preparation as well as potassium was applied as potassium sulphate (48% K₂O).

The characters studied in this respect were:

- 1- Plant height: at harvest, measured in cm from surface of the soil to the top of the spike of five main stems.
- 2- Spike length, cm.
- 3- Number of spikelets per spike.
- 4- Number of spikes/m².
- 5- Seed index, i.e. 1000 grain weight, gm.
- 6- Grain yield ardab/fed.
- 7- Straw yield in ton/fed.

Statistical analysis:

The obtained data in each season were statistically analyzed according to procedure outlined by Gomez and Gomez (1984). Means comparison were done using revised least significant differences (RLSD) at 5% level of probability.

Results and Discussion:

Effect of varieties:

Data in table 2 showed that the spike length, 1000 grains weight and straw yield/fed. in both seasons had a highly significantly as well as the number of spikelets/ spike and number of spikes/m² in the 1st season only had a significantly affected by the wheat varieties. On the other hand, the plant height and grain yield/fed. in both season as well as the number of spikelets/spike and number of spikes/m² in the 2nd season had non-significant affected by the wheat varieties. It is clear that the wheat varie-

ty (Giza 168) gave a significant increase in the spike length (cm), 1000 grains weight (gm) and straw yield/fed. (ton) in both seasons as well as in the 1st season only for the number of spikelets/spike and number of spikes/m². The results indicated that the wheat variety (Bani-Swef 1) gave the lowest values for the all studied traits. Moreover, the tallest plants gave maximum straw yield/fed., as well as the increase of spike length and 1000 grains weight (gm) may be realized increase in the grain yield/fed. This result may be due to the genotypes make up reflecting improvement in yield components. Zaki *et al.* (2012) reported that Sakha 93 cultivar gave higher number of spikes/m² and grain yield (ton/fed.) than Gemmiza in both seasons. Varietal differences in yield components between wheat varieties were in conformity with those obtained by El-Habbal *et al.* (2000), Hassan and GabAllah (2000), Hossain *et al.* (2002), Allam *et al.* (2007), El-Metwally and Saady (2009) and Noureldin *et al.* (2013) who reported that a significant differences among the tested wheat cultivars in the two seasons for number of spike/m², spike length, kernel number/spike, weight of 1000 kernels and grain and straw yields/fed.

Effect of the seed soaking in micronutrient solution:

The data in table 2 showed that the all studied traits had a highly significant affected by the soaking in micronutrients solution in both seasons. The tallest plants (99.90 and 99.03 cm), the tallest spike (10.58 and 11.30 cm), the heaviest 1000 grains (48.16 and 50.40 gm), the highest values of number of

spikelets/spike (20.13 and 20.86), number of spikes/m² (486.9 and 491.8) the maximum grains yield/fed. (19.32 and 18.96 ard.) and the maximum straw yields/fed. (3.97 and 4.37 ton) were recorded by the three elements mixture treatment (Fe + Mn + Zn) in the 1st and the 2nd seasons, respectively. Moreover, the plants treated with Fe+Zn, Zn+Mn and Fe+Mn treatments had significant increase in all studied traits over the control treatment (unsoaked grains) in both seasons. Generally, all treatments receiving micronutrient: Fe, Zn and Mn either alone or combined together gave the highest values over the control in both seasons. Here, the results emphasized the important role for the trace elements (Fe, Zn and Mn) to increase the plant height, yield and yield attributes under this study, as well as showed that the synergetic role of micronutrients in improving plant growth and other biochemical and physiological activities. Brennan (2001) observed that applied zinc fertilizers increased wheat dry weight and grain yield. Similar findings were reported by Teama (2001) who found that the use of a single element for soaking was better than the control. All the two element mixtures were better than single element as well as the three-element mixture was the best of all soaking treatments. Masoud *et al.* (2004) reported that applying zinc increased grain yield, straw yield and 1000 grain weight. Moreover, zinc is the essential act as a metal-activator for the synthesis of plant growth regulators like auxin, also of several enzymes, involved in the synthesis of protein and nucleic acids in plants. These are in agreement with those reported by Zaki *et al.* (1992), Saad *et al.* (1999), Asad and Rafique

(2000), Brennan (2001), Liu *et al.* (2006), Hao *et al.* (2007), Pearson *et al.* (2008), Pahlavan-Rael and Pes-sarkli (2009) and Salem and El-Gizawy (2012) who reported that number of ears/plant, number of grains/ear, 100-grain weight and grain yield increased by applying Zn, Mn and Fe singly or combined. Such increases were particularly significant by the Zn+Mn+Fe treatment with regard to 100-grain weight, ear weight and grain yield.

Effect of the interactions:

The data in table 3 revealed that the all studied traits had non-significant affects by the varieties with soaking grains in micronutrient interactions in the both seasons. Although the insignificant effect for all the studied traits by the interactions, the results indicated that the best values (102.20 and 100.10 cm), (11.7 and 12.4 cm), (21.20 and 21.83), (546.5 and 551.0), (19.05 and 19.32 ard/fed.) and (4.34 and 4.73 ton/fed.) were realized by V1xC8 interaction (Giza 168 variety x soaking grains in Fe+Mn+Zn micronutrients) for the plant height, spike length, number of spikelets/spike, number of spikes/m², grain yield/fed. and straw yield/fed. in the 1st and the 2nd seasons, respectively. The lowest values (88.75 and 89.00 cm), (74.3 and 7.60 cm), (16.20 and 16.65), (180.0 and 190.0), (15.95 and 15.43 ard.) and (3.18 and 3.38 ton) were detected by the V2xC1 interaction of Bani-Swef 1 variety x control treatment for the above same traits in the 1st and 2nd seasons, respectively. On the other hand, the heaviest 1000 grains (90.48 and 53.03 gm) followed by (49.98 and 52.54 gm) were obtained by interaction of Bani-Swef 1 var. x Fe+Mn+Zn micronutrient treatment followed by

interaction of Bani-Swef 1 var. x Fe+Zn micronutrient treatment), while the thinnest 1000-grains (38.09 and 40.66 gm) were achieved by interaction of Giza 168 var. x control treatment in the 1st and the 2nd seasons, respectively. Generally, the results emphasized that the Giza 168 var. (bread wheat) surpassed the Bani-Swef 1 var. (durum wheat) under different soaking grains by micronutrients either alone and/or mixture and therefore, it may be recommended that soaked grains of Giza 168 variety in micronutrients solution of Fe+Mn+Zn.

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تأثير نقع حبوب القمح في محاليل العناصر الصغرى علي المحصول ومكوناته
نادية محمد محمود ، المهدي عبد المطلب طعيمة ، عادل مصطفى أبو سلامة و أنعام حلمي جلال
قسم المحاصيل - كلية الزراعة - جامعة أسيوط

المخلص:

أجري هذا البحث بمزرعة كلية الزراعة - جامعة أسيوط خلال موسمي الزراعة الشتوية ٢٠١٠/٢٠٠٩ و ٢٠١١/٢٠١٠ لدراسة تأثير نقع حبوب القمح في محاليل العناصر الصغرى علي المحصول ومكوناته وكان التصميم المستخدم هو القطاعات الكاملة العشوائية للقطع المنشقة لمرة واحدة في أربع مكررات. وضعت الأصناف جيزة ١٦٨ و بني سويف ١ في القطع الرئيسية بينما وضعت معاملات العناصر المغذية (الحديد - الزنك - المنجنيز - الحديد والمنجنيز - الزنك والمنجنيز - الحديد والزنك) في القطع المنشقة. وكانت مساحة القطعة التجريبية هي ٣×٣ م ٠.٢. ويمكن تلخيص النتائج كما يلي:

- تفوق الصنف جيزة ١٦٨ علي الصنف بني سويف ١ وأعطى زيادة معنوية لطول السنبلية ووزن الألف حبة ومحصول القش في كلا الموسمين، كما أعطى أيضاً في الموسم الأول فقط زيادة معنوية لعدد السنييلات/سنبلية وعدد السنابل/م ٠.٢.

- سجلت المعاملة الحديد والمنجنيز والزنك أعلا قيمة لكل من طول النبات، طول السنبلية، وزن الألف حبة، عدد السنييلات / سنبلية، عدد السنابل/م ٠.٢ ، محصول الحبوب / فدان ومحصول القش / فدان في كلا الموسمين.

- لم تتأثر جميع الصفات المدروسة معنوياً بالتفاعل بين الأصناف ومعاملات العناصر المغذية في كلا الموسمين.