# SEED QUALITY (Fe AND Zn CONTENTS) OF WHEAT GENOTYPES

Sadullah N. Al-Niemi
Univ. of Mosul, College of Agric. and Forestry, Dept. of Soil and Water Sciences, Mosul, Iraq.

Mohammed Sedqi S. Dohuki Suzan Salih Barwary
Univ. of Dohuk, College of Agric., Dept. of Soil Sciences and Water, Dohuk, Iraq.

## ABSTRACT

In the lab study, seeds of 18 wheat genotypes were tested for their concentrations and contents of Fe and Zn to determine the seed quality . The iron concentrations in the seed of the 18 wheat genotypes ranged between 20.5 to 65.4 mg $kg^{-1}$ dry weight basis. Only the seed of Saef and Bohuth/6 genotypes had Fe concentration more than 57 mg $Kg^{-1}$ and fulfill quality standard set by WHO, 2006, were as six of seed genotypes had more than 41mg Zn $Kg^{-1}$ namely Saef, Karoniah, Zebba/5, Abo-Ghraib, Sham/3 and Pash/29. The results also showed that for the two genotypes with the highest Fe concentration, only Saef was the genotype that had higher Zn concentration more than 41 mg Zn $Kg^{-1}$ the quality standard. In contrast to Zn , the variation for seed Fe content was not greater than variation found for the concentration.

Key words: Wheat, Seed Quality, Fe and Zn Contents.

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## INTRODUCTION

Micronutrient deficient soil is critical issues in the developing countries (Iraq is one of them), and result in severe impairments of human health and developments (Pinstrup–Anderson, 1999, Welch and Graham 2000). In humans deficiencies of essential micronutrients such as iron and zinc are wide spread. In many regions of the world, a large proportion of dietary intake of these nutrients is derived from grains. More than three billion people globally suffer from Fe and Zn deficiencies (Cakmak et al., 2002).

In plants Fe and Zn deficiency often occurs in calcareous soil where chemical availability of Fe and Zn to plant root are extremely low. Correction of Fe or Zn deficiency are not always easy through the use of Fe or Zn fertilizers because of their extremely poor solubility.

Remediation of Fe and Zn deficiencies in calcareous soils by fertilizers only is a costly and time consuming management .Therefore we think that screening for micronutrients – efficient varieties for micronutrients deficient soil with a combination of mineral fertilizers and larger seed size (with higher Fe and Zn content) is an important practical approach for the correction or avoidance of Fe and Zn deficiencies in cereals (Welch, 1986; Rengel and Graham 1995) leading to higher yield. To our knowledge, until now in Iraq no data are available about seed micronutrient contents. The present study was conducted to assess the Fe and Zn concentration and contents of different wheat genotypes to provide an insight into the quality of the seed for human consumption and it's resowing for better crop harvest.

## MATERIALS AND METHODS

**Seed preparation and micronutrients concentrations and contents determination:** The lab study conducted to determine seed quality (Micronutrients content) of 18 new wheat genotypes brought from ICARDA (International Center for Agricultural Research in the Dry Areas, Syria. The Fe and Zn concentrations and contents of each genotype were determined. The method described by Chapman and Pratt (1961) was used to measure the seed- micronutrient concentration. Seeds weights of all genotypes were measured. The data were statistically analyzed by analysis of variance and F tests. Significance of differences between means was evaluated by the least significant difference test (Adj. LSD) at the 0.05 level of probability.

## RESULTS AND DISCUSSION

**Iron concentrations and content:** Iron concentrations in the seed of different wheat genotypes ranged between 20.5 to 65.40 mg $kg^{-1}$ on dry weight basis (Table 1). The highest Fe concentration (65.40 mg $kg^{-1}$) was recorded in the seed of Saef genotype, whereas the lowest Fe concentration of 20.5 mg $kg^{-1}$ was exhibited by Doma/1 variety. The genotypes Bohuth/6, Abo-Ghraib, Sham/8, Bohuth/7, Adil/3, Bohuth/4, Jawaher, IPA/99 and Tilaafar also proved to be the higher accumulator of Fe and good Fe absorber as compared with other wheat genotypes. The lowest Fe concentrations in the seeds of the genotypes Zebba/5, Asel, Karoniah, Acsad/65, Sham/3, Haama/14, Pasha/29 and Doma/1 (Table 1) suggest either severity of Fe deficiency problem in the region of these varieties or lower Fe efficiency of these genotypes. These results are in agreement to those obtained by Rengel and Graham (1995) and to those obtained by Imtiaz et al., (2003). Iron contents per seed have been presented in (Table 1). The genotypes exhibited significant variations in Fe contents of their single seed. Iron contents within the seed ranged between 1.136 μg $seed^{-1}$ to 2.871 μg $seed^{-1}$, when calculated on oven dry weight basis. As with Fe concentrations, Fe contents were also higher in the seed of Saef, Bohuth/6, Jawaher, Abo-Ghraib, Bohuth/7, IPA/99, Tilaafar/3, Sham/8, Adil/3 and Bohuth/4 genotypes than the other genotypes. The amount of micronutrients in grain depends on the amount taken up by the roots during grain development and the amount redistributed in the grain from vegetative tissue by the phloem. The amount of each nutrient element remobilized by the phloem is greatly dependent on the phloem mobility of each element (Garnett and Graham 2005). Kochian (1991) investigated Fe transport into remobilization from leaves and found that iron has intermediate phloem mobility. Zinc showed good remobilization, whereas Mn remobilization was poor (Pearson and Rengel 1994).

**Zinc concentration and content:** The wheat genotypes were exhibited significant variations in the zinc concentrations of their seeds (Table 2). Zinc concentrations in the seed of different wheat genotype ranged between 4.73 mg Zn $kg^{-1}$ to 53.30 mg Zn $kg^{-1}$ on dry weight basis. The highest Zn concentration (53.30 mg $kg^{-1}$) was recorded in the seed of saef genotype, whereas the lowest Zn concentration of (4.73) mg $kg^{-1}$) was exhibited by Sham/8 genotype, followed by Bohuth/6, Tilaafar/3, Haama/14, Bohuth/4, Acsad/65, Adil/3 and Asel genotypes.The higher seed Zn concentration genotype proved to be higher accumulator of Zn as stated by Rengel

Table (1): Iron concentration (mg $Kg^{-1}$), seed weight and content in the seed (original seed size) of 18 wheat genotypes used in the present study.

| Genotypes | Fe conc. Mg $kg^{-1}$ mg | Seed weight (gm) | Fe content µg $seed^{-1}$ |
|---|---|---|---|
| Saef | 65.400 | 0.0439 | 2.871 |
| Bohuth/6 | 64.400 | 0.0411 | 2.647 |
| Abo-Ghraib | 56.267 | 0.0400 | 2.251 |
| Sham/8 | 53.800 | 0.0354 | 1.905 |
| Bohuth/7 | 52.733 | 0.0429 | 2.262 |
| Adil/3 | 52.000 | 0.0356 | 1.851 |
| Bohuth/4 | 51.133 | 0.0364 | 1.861 |
| Jawaher | 50.933 | 0.0470 | 2.394 |
| IPA/99 | 50.867 | 0.0407 | 2.070 |
| Tilaafar/3 | 50.600 | 0.0379 | 1.918 |
| Zebba/5 | 47.133 | 0.0380 | 1.791 |
| Asel | 42.600 | 0.0425 | 1.811 |
| Karoniah | 41.667 | 0.0430 | 1.792 |
| Acsad/65 | 40.333 | 0.0462 | 1.863 |
| Sham/3 | 39.933 | 0.0415 | 1.657 |
| Haama/14 | 34.733 | 0.0391 | 1.358 |
| Pasha/29 | 32.467 | 0.0418 | 1.357 |
| Doma/1 | 20.500 | 0.0554 | 1.136 |
| Adj.LSD | 2.305 | 0.0029 | 0.196 |

and Graham (1995). Zinc contents per seed have been presented in (Table 2), and ranged between 0.168 µg $seed^{-1}$ to 2.34 µg $seed^{-1}$ when calculated on oven dry weight basis. The genotype Saef showed the highest zinc content followed by Karoniah, Abo-Ghraib and both Pasha/29 and Jawaher genotypes as compared with the other 13 genotypes.

**Grain quality standards:** Based on personal daily requirement of Fe and Zn, and the information of bioavailability provided by the WHO (2006) the concentrations of Fe and Zn have been proposed to be elevated to 57 and 41 mg $Kg^{-1}$ respectively. These quality standards were used by Zhang et al., 2010 and Imtiaz et al., 2010.Only Saef and Bohuth/6 from the 18 genotypes used infulfill the quality standard set by WHO, 2006 and had high Fe concentration more than 57 mg $Kg^{-1}$ and it was found that the other 16 genotypes had low Fe concentration less than 57 mg Fe $Kg^{-1}$ (Table 1) , where as six of genotypes had higher Zn concentration more than 41 mg Zn $Kg^{-1}$ namely Saef, Karoniah, Zebba/5, Abo-Ghraib, Sham/3 and Pasha/29 (Table 2). For the two genotypes with the highest Fe concentration, only Saef was the genotype had higher Zn concentration more than 41mg $Kg^{-1}$. Therefore, there is sufficient genetic variability to develop wheat genotypes with increased Zn levels in the grain and promising genetic variability for Fe.

Information on mineral nutrient reserves in seed should be perfect from agricultural point of view and human requirements as well. It could provide an insight into these genotypes which are high mineral element accumulators, and can best be utilized for human consumption as well as agricultural production. The high concentrations of Fe and Zn for Saef and Abo-Ghraib (Tables 1, 2) ranked it as the leading genotypes in Fe and Zn concentration, and this made it the most promising genotypes.
Table (3) provides total amount of Fe and Zn per seed (content) in addition to the Fe and Zn concentrations in seeds of wheat genotypes. The variation for Zn content in seed was much greater when compared to the variation found for the concentration. This indicates large differences for seed weights among genotypes by contrast; the variation for Fe content was not greater when compared to the variation found for the concentration.

Table (2): Zinc concentration (mg $kg^{-1}$), seed weight and content in the seed (original seed size) of 18 wheat genotypes used in the present study.

| Genotypes | Zn conc. Mg $kg^{-1}$ mg | Seed weight (gm) | Zn content µg $seed^{-1}$ |
|---|---|---|---|
| Saef | 53.300 | 0.0439 | 2.340 |
| Karoniah | 51.067 | 0.0430 | 2.196 |
| Zebba/5 | 46.600 | 0.0380 | 1.771 |
| Abo-Ghraib | 45.100 | 0.0400 | 1.804 |
| Sham/3 | 43.800 | 0.0415 | 1.818 |
| Pasha/29 | 42.800 | 0.0418 | 1.789 |
| IPA/99 | 40.267 | 0.0407 | 1.639 |
| Jawaher | 38.100 | 0.0470 | 1.791 |
| Bohuth/7 | 31.300 | 0.0429 | 1.343 |
| Doma/1 | 27.867 | 0.0554 | 1.544 |
| Asel | 25.467 | 0.0425 | 1.082 |
| Adil/3 | 21.900 | 0.0356 | 0.780 |
| Acsad/65 | 19.267 | 0.0462 | 0.890 |
| Bohuth/4 | 19.200 | 0.0364 | 0.699 |
| Haama/14 | 14.400 | 0.0391 | 0.563 |
| Tilaafar/3 | 13.067 | 0.0379 | 0.495 |
| Bohuth/6 | 6.667 | 0.0411 | 0.274 |
| Sham/8 | 4.733 | 0.0354 | 0.168 |
| Adj.LSD | 5.599 | 0.0029 | 0.246 |

Table (3): Seed concentration of Fe and Zn of various wheat genotypes (18)from different sources.

| | Concentration(mg $Kg^{-1}$dry weight) التركيز (ملغرام/كغم مادة جافة) | | Content (μg $Seed^{-1}$) المحتوى (مايكروغرام/حبة) | |
|---|---|---|---|---|
| | Median | Range | Median | Range |
| Fe | 50.73 | 20.50 - 65.00 | 1.84 | 1.13 - 2.87 |
| Zn | 29.58 | 4.73 - 53.30 | 1.42 | 0.17 - 2.32 |

**نوعية الحبوب (المحتوى من Fe و Zn) للأنماط الوراثية لنبات الحنطة**

سعد الله نجم النعيمي محمد صدقي دهوكي سوزان صالح برواري

قسم علوم التربة والموارد المائية- كلية الزراعة والغابات جامعة الموصل- الموصل / العراق
قسم علوم التربة والموارد المائية - كلية الزراعة - جامعة دهوك- دهوك / العراق

**الخلاصة**

أجريت تجربة مختبرية اختبر فيها محتوى 18 نمط وراثي لنبات الحنطة من الحديد والزنك وذلك لمعرفة نوعية الحبوب. تركيز الحديد في حبوب هذه الأنماط الوراثية كان بالمدى 20.0 – 65.4 مايكرو غرام/ غرام مادة جافة. فقط حبوب النمطيين الوراثيين سيف وبحوث/ 6 ذات تركيز للحديد أعلى من 57 ملغم/ كغم وبما ينسجم مع الحد المعتمد من قبل منظمة الصحة العالمية، بينما كان هناك ستة أنماط وراثية ذات تركيز من عنصر الخارصين أعلى من 41 ملغم/ كغم وهي سيف، كارونيا، زيبا/5، أبو غريب، شام/3 وباشا/29. النتائج أيضا أشرت بأنه من بين النمطيين الوراثيين ذات التركيز العالي من Fe فقط النمط الوراثي سيف كان تركيز الخارصين فيه أعلى من 41 ملغم/ كغم. ووجد من النتائج وبشكل مغاير لعنصر الخارصين إن الاختلاف في محتوى الحبوب من عنصر الحديد لم يكن اكبر من الاختلاف الذي وجد مع تركيز الحديد.

كلمات دالة: الحنطة ، نوعية الحبوب ، المحتوى من الحديد والزنك.

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