SEED SIZE AND SEED QUALITY EFFECTS ON SEEDDLING GROWTH OF BARLEY VARIETIES GROWN IN Fe AND Zn DEFICIENT CALCAREOUS SOIL

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ABSTRACT

Greenhouse experiment was carried out to study the effects of seed size and seed iron and zinc content on seedling growth of 15 promising and dominant varieties of barley plant in the North part of Iraq. Three groups of seed size with different seed quality (Fe and Zn content) of each variety were sown in Fe and Zn deficient alkaline calcareous soil. After six weeks root and shoot dry weights of barley plants grew from different seed size and seed quality were compared. Seedlings derived from larger seed size and with high Fe and Zn content had greater root and shoot dry weights. Barley varieties El-Kheir, 1/1105,Amal and local black performed better seedling growth.

INTRODUCTION

Micronutrient content of seeds is important for the nutrition of plant seedling and this effect is most pronounced in micronutrient deficient soil (Rengel and Graham, 1995, Yilmaz *et al*., 1997). Seed size and seed micronutrient content roles on seedling growth under Fe and Zn deficient condition is rarely studied.In Iraq there is no such kind of studies. In this study, the objectives were to investigate the effects of seed size and its micronutrients (Fe and Zn) content on the early growth of 15 promising and dominant barley varieties grown in north part of Iraq, on calcareous soil.

MATERIALS AND METHODS

Greenhouse experiment was conducted to determine the effects of seed size and seed micronutrients (Fe and Zn) content on the early growth of 15 different barley varieties (El-Kheir, Boraq, Ghallion, 1/1105, Haddhar-465, Amal, Al-Bawadi, Sameer, Local black, Biba-99, ACSAD-14, ACSAD-2, ACSAD-9, ACSAD-12 and Najim Al-deen). The seeds of the 15 promising and dominant varieties were collected from the agriculture research stations which located in Dohuk and Erbil governorates in north part of Iraq. Seeds of each variety were sieved and separated to three seed size groups {retained on 4.0 mm mesh (group I), passed through a 4.0 mm mesh and retained on 3.0 mm mesh (group II), and passed through a 3.0 mm mesh and retained on 2.36 mm mesh (group III)}. Iron and Zinc in seeds of each group size and of each barley variety were determined by using method described by Chapman and Part (1961).

Micronutrient (Fe and Zn)-deficient calcareous silty clay soil with about 21% $CaCO_3$ and pH 8.6 (Table 1) was collected from the field experiment station at the

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college of Agriculture, Dohuk University, Northern Iraq. PVC pots (9.5 cm diameter × 11cm length) were filled with 500g air-dry soil. Eight seeds from each group size were sown in each pot, and distilled water was added in amounts sufficient to bring soil water content to 75% of soil field capacity. Soil moisture content was kept at 75% of field capacity during the period of the experiment by weighing the pots daily and adding by distilled water to obtain the original wet weight. After germination plants were thinned to 4 plants per pot, and after 45 days from sowing plants were harvested. At harvest time soil was washed off root under running tap water. Both roots and shoots were separated gently and weighed.

RESULTS AND DISCUSSION

Physical and chemical characteristics of soil :Various physiochemical properties of soil are presented in (Table 1). Soil was calcareous which contained more than 200 $CaCO_3$ gm kg^{-1}soil and characterized by very low organic matter content 15.5gm kg^{-1}soil and had high pH value 8.6. Concentration of DTPA-extractable Fe in soil was 2.79 mg kg^{-1} soil which was less than the adequate amount of Fe in calcareous soils (4 mg kg^{-1}soil) as stated by Soltanpour and Schwab (1977), and it was marginal with the critical level for calcareous soils (2.5 mg kg^{-1}soil) obtained by Sims and Johnson (1991), while the zinc concentration of the soil was 0.55 mg kg^{-1}soil which was less than marginal amount of Zn in calcareous soils (0.6-1.0 mg kg^{-1}soil) as (Soltanpoure and Schwab, 1977) stated, and was very close to the critical level (0.5 mg kg-1soil) obtained by Sims and Johnson(1991). The soil texture silty clay with high fractions of both silt and clay and low fraction of sand.

Table (1): Physicochemical properties of top soil sample (0-30) cm.

pH	8.6	Sand (g kg^{-1})	90.60
$CaCO_3$ (gm Kg^{-1}soil)	201.0	Silt (g kg^{-1})	487.50
Organic matter (gm Kg^{-1}soil)	15. 5	Clay (g kg^{-1})	421.90
Available Fe (mg Kg^{-1}soil)	2.79	Soil texture	Silty clay
Available Zn (mg Kg^{-1}soil)	0.55	Moisture at Field capacity (%)	31.68

Seed Size and Seed micronutrients content: The effect of seed size was significant for seed micronutrients (Fe and Zn) content (Table 2). The large seed size had a bigger store of Fe and Zn nutrients. Seeds of the 15 barley varieties varied significantly (Table 2) in their Fe and Zn content and therefore, the seed Fe content was higher than that of Zn. Najim Al-deen and ACSAD-2 varieties showed the lowest seed Fe content, while Biba-99 and ACSAD-2 showed the lowest seed Zn content.

Root dry matter: Root dry matter production of the barley seedling was influenced by seed size and seed micronutrients content as well as was by barley varieties. Large seed size which contained highest amount of (Fe and Zn) significantly resulted in better root production (Table 3) than the other two seed size groups. Barley variety also had significant effect in root dry matter production, where Al-Bawadi, Amal and ACSAD-9 varieties had higher root dry matter as compared to other barley varieties.

Shoot dry matter: Seed size and seed micronutrients content effect on shoot dry matter production were very similar to the effect on root dry matter production

(Table 3). Seedling derived from larger size which had a bigger store of micronutrients (Table 4) produced more shoot dry matter. The results also showed significant variation in shoot dry matter production under the effect of barley varieties. El-kheir variety had higher shoot dry matter production while Najim Aldeen produced significantly less shoot growth.

Table (2): Effects of barley variety and seed size group (I, II and III) on Fe and Zn seed content.

Barley varieties	(µg Fe Kg^{-1})			(µgZn Kg^{-1})			Average variety nutrient content (µg Kg^{-1})	
	I	II	III	I	II	III	Fe	Zn
El-Kheir	١٦١.١٣	١٤٣.٢٧	١٣٢.٢٠	٦٨.٠٠	٦٣.٣٣	٥٥.٢٧	١٤٥.٥٣	٦٢.٢٠
Buraq	١٦٠.١٣	١٣٦.٠٧	٩١.٢٠	٧٨.٠٧	٥٤.١٣	٤٧.٦٠	١٢٩.١٣	٥٩.٩٣
Ghallion	١٧٧.١٣	١٦٣.٦٠	١٣٦.٢٧	٦١.٠٠	٥٥.١٣	٥١.٢٠	١٥٩.٠٣	٥٥.٧٨
1/1105	١٣٥.٨٠	١١٤.٢٧	١١٥.٧٠	٥٦.١٣	٥١.٢٧	٥٢.٣٣	١٢١.٩٢	٥٣.٢٤
Haddhar-465	١٣٣.٣٣	١١٧.١٣	١٢٦.٢٠	٦٨.٥٣	٥٢.١٣	٤٧.٠٧	١٢٥.٥٦	٥٥.٩١
Amal	١٨٤.٢٧	١٣٣.١٣	١٤٤.٠٧	٦١.٢٠	٤٣.١٣	٤٨.٠٧	١٥٣.٨٢	٥٠.٨٠
Al-Bawadi	١٨٤.٠٤	١٠٤.٢٧	١٠٧.١٣	٦٦.١٣	٤٢.٤٠	٥٢.١٣	١٣١.٩٣	٥٣.٥٦
Sameer	١٧٠.٦٠	١٣٥.٢٠	١٦٣.٢٧	٦٦.١٣	٤١.١٣	٤١.٨٠	١٥٦.٣٦	٤٩.٦٩
Local black	١٤٥.٢٧	١٢٦.٤٧	١٢٢.٢٠	٥٧.٠٧	٤٤.٨٠	٤٦.٠٧	١٣١.٣١	٤٩.٣١
Biba-99	١٢٨.٤٧	١٠٥.١٣	١٠٧.٣٣	٤٦.٣٣	٤٥.٦٠	٣٢.٦٧	١١٣.٦٤	٤١.٥٣
ACSAD-14	١٨٢.٢٠	١٤٩.٢٧	١٤٨.٢٧	٦٥.٢٧	٦٥.٢٠	٥٤.٠٧	١٥٩.٨٩	٦١.٥١
ACSAD-2	١٤١.٣٣	١٠٤.١٣	٧١.١٣	٤٧.٠٠	٤٤.٠٧	٤١.٢٠	١٠٥.٥٣	٤٤.٠٩
ACSAD-9	١٤٧.٦٠	١٣٥.٠٠	٧٢.٧٣	٨٨.٢٧	٧٧.٠٣	٥٦.٠٠	١١٨.٤٤	٧٣.٨٤
ACSAD-12	١٥٨.٣٣	١٣٩.٠٧	١٤٠.٠٧	٧٢.٦٧	٥٧.٠٧	٦٢.١٣	١٤٥.٨٢	٦٣.٩٦
Najim Al-deen	١٢٨.٠٧	٨٥.٢٠	٦٢.٥٣	٦٨.٢٠	٦٤.٢٠	٤٢.٢٠	٩١.٩٣	٥٨.٢٠
Variety × Seed size effect Adj. LSD, 0.05	٢١.١٨			٢١.٦٦			١٢.٢٣	١٢.٥١

Seed size micronutrient content (µg Kg^{-1})		
group	Fe	Zn
I	١٥٥.٨٨	٦٤.٦٧
II	١٢٦.٠٨	٥٣.٣٩
III	١١٦.٠٢	٤٨.٦٥
Seed size effect Adj. LSD, 0.05	٥.٤٧	٥.٥٩

The results demonstrated that seed size and seed micronutrients content can improve an early growth of root and shoot of seedling varieties growing in alkaline calcareous soil. These result are consistent with the finding of Rengel and Graham, (1995) Mousavi-Nik *et al*.(1997) were a more vigorous crop is established by seeds with a high density of nutrients, including micronutrients, and with the results of (Main and Nafziger, 1992) who stated that seed size is an important determinant of seedling vigour and early growth of cereals.

Root and shoot growth were decreased significantly in seedling grown from small seed size with low Fe and Zn content, and the reduction of root and shoot growth using seeds from group III, and group II were 29.24% and 15.38%, respectively for the root growth as compared to the root growth using seeds from group I and 30. 93% and 12.14%, respectively for the shoot growth. This reduction in root and shoot growth was attributed to insufficient of micronutrients supply which in turn decrease the plant metabolism and functions (Marschner, 1995, Mengel and Kirkby. 2001).

Barley varieties El-kheir, 1/1105, Amal and local black generally gave higher seedling growth and performed better than other varieties. Seed size and seed

micronutrients content are an important factors for screening a large number of barley varieties depending on root and shoot growth parameters.

Table (3): Effects of barley seed size group (I, II and III) on root dry weight of seedling.

Barley varieties	Root dry weight (g pot^{-1})			Variety × seed size effect Adj. LSD, 0.05	root dry weight (g pot^{-1})	Variety Adj. LSD, 0.05
	I	II	III			
El-Kheir	٠.٢٠٠	٠.١٧٩	٠.١٠٦	٠.٠٤٧	٠.١٦٢	٠.٠٢٧
Buraq	٠.١٧٤	٠.١٣٤	٠.١٢٧		٠.١٤٥	
Ghallion	٠.١٩٢	٠.١٣٩	٠.١٢٥		٠.١٥٢	
1/1105	٠.١٩٣	٠.١٩٠	٠.١٢٥		٠.١٦٩	
Haddhar-465	٠.٢٢٢	٠.١٦١	٠.١٣٠		٠.١٧١	
Amal	٠.٢٢٦	٠.١٨٧	٠.١٨٥		٠.١٩٩	
Al-Bawadi	٠.٢٦١	٠.١٩٨	٠.١٦٩		٠.٢٠٨	
Sameer	٠.١٦٠	٠.١٥٨	٠.١٣٢		٠.١٥٠	
Local black	٠.١٩٥	٠.١٧٠	٠.١٤٣		٠.١٦٩	
Biba-99	٠.١٥١	٠.١٥٠	٠.١٣١		٠.١٤٤	
ACSAD-14	٠.١٨٩	٠.١٤٣	٠.١٧٢		٠.١٦٨	
ACSAD-2	٠.١٩٢	٠.١٧٦	٠.١٠٨		٠.١٥٩	
ACSAD-9	٠.٢٢٠	٠.١٧٩	٠.١٧٣		٠.١٩١	
ACSAD-12	٠.٢٠٤	٠.١٦٩	٠.١٠٤		٠.١٥٩	
Najim Al-deen	٠.١٤٦	٠.١٤٤	٠.١٣٨		٠.١٤٣	
Seed size group	root dry weight (g pot^{-1})			Seed size effect Adj. LSD, 0.05		
I	٠.١٩٥			٠.٠١٢		
II	٠.١٦٥					
III	٠.١٣٨					

Table (4): Effects of barley variety and seed size group(I, II and III) on shoot dry weight of seedling.

Barley varieties	shoot dry weight (g pot^{-1})			Variety × seed size effect Adj. LSD, 0.05	Shoot dry weight (g pot^{-1})	Variety effect Adj. LSD, 0.05
	I	II	III			
El-Kheir	٠.٤٣٦	٠.٣٧٧	٠.٢٧٨	٠.٠٩٨	٠.٣٦٤	٠.٠٥٦
Buraq	٠.٣١٩	٠.٣٠٤	٠.٢٢٨		٠.٢٨٤	
Ghallion	٠.٣٦١	٠.٣٥٠	٠.٢٤٢		٠.٣١٨	
1/1105	٠.٤١٢	٠.٤١١	٠.٢٢٤		٠.٣٤٩	
Haddhar-465	٠.٣٤٣	٠.٢٤٥	٠.٢٢٤		٠.٢٧١	
Amal	٠.٣٣٩	٠.٣٢٧	٠.٣١٦		٠.٣٢٧	
Al-Bawadi	٠.٣٣١	٠.٢٣٧	٠.١٧٨		٠.٢٤٩	
Sameer	٠.٣١٢	٠.٢٨٦	٠.٢٥٨		٠.٢٨٦	
Local black	٠.٤٠٢	٠.٣٠٤	٠.٢١٢		٠.٣٠٦	
Biba-99	٠.٢٩٣	٠.٢٩٢	٠.٢٨٣		٠.٢٨٩	
ACSAD-14	٠.٣٥٨	٠.٢٨٠	٠.٢٤٢		٠.٢٩٣	
ACSAD-2	٠.٣٠٠	٠.٢٨٩	٠.١٧٠		٠.٢٥٣	
ACSAD-9	٠.٣١٣	٠.٣٥٠	٠.٢٥٣		٠.٣٠٥	
ACSAD-12	٠.٤٠٠	٠.٢٧٤	٠.٢٧٤		٠.٣١٦	
Najim Al-deen	٠.٢٦٦	٠.٢٢٧	٠.٢٠٤		٠.٢٣٢	
Seed size group	Shoot dry weight (g pot^{-1})			Seed size effect Adj. LSD, 0.05		
I	٠.٣٤٦			٠.٠٢٥		
II	٠.٣٠٤					
III	٠.٢٣٩					

Our results suggests that larger seed size and higher seed micronutrients content are very important for early seedling growth and might be overcome

problems temporary of insufficient micronutrient content of alkaline calcareous soil.To our knowledge this is the first study and report of a large project in Iraq dealing with screening for micronutrients efficient and inefficient varieties of cereals and its adaptive strategies in calcareous soil.

تأثير حجم البذور ونوعيتها في نمو البادرات لأصناف الشعير النامية في تربة كلسية تعاني من نقص الحديد والزنك

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الخلاصة

أجريت تجربة في البيت الزجاجي لدراسة تأثير حجم البذور ومحتواها من الحديد والزنك في نمو بادرات خمسة عشر صنفا واعدا وسائدا في شمال العراق لنبات الشعير . زرعت بذور ثلاثة مجاميع حجمية ذات نوعية (المحتوى من الزنك والحديد) مختلفة لكل صنف في تربة قاعدية كلسية تعاني من نقص الحديد والزنك. لقد تم مقارنة الأوزان الجافة للأجزاء العليا والجذور لأصناف نبات الشعير بعد ستة أسابيع من الزراعة. البادرات التي نشأت من البذور ذات الأحجام الكبيرة وذات المحتوى العالي من الحديد والزنك كانت أوزان أجزاءها العليا والجذور الجافة هي الأعلى. وأعطت أصناف الشعير الخير ، ١١٠٥ / ١، امل والأسود المحلي أفضل نمو للبادرات مقارنة مع الأصناف الأخرى.

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