Growth, Yield and Yield components of Maize (Zea maize) as influenced by seeds soaking periods in some micronutrients solutions.

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ABSTRACT

This study was carried out during the summer season of 2010 at the Agricultural Research Station, Sebha, Libya to study effect of soaking seeds in four micronutrients solutions (Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu) and three soaking periods (3,6 and 9 hours) as well as their interactions on growth and yield of maize crop.

The main results showed that, all treatments of soaking seeds in micronutrients, soaking periods and their interactions significantly increased plant height, seed weight per plant and hectare comparing to control.

Soaking seeds in micronutrients solutions (Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu) increased the mean values of plant height by 10.62, 15.85, 15.06 and 10.38%, respectively as compared with soaking seeds in distilled water. Increasing soaking durations in micronutrients solutions (6 and 9h) increased plant height, the mean values of plant height increased by 4.42 and 8.78%, respectively as compared with 3h soaking duration.

The maize yield increased by 32.98, 40.84, 37.50 and 21.75 % as compared with the control treatment for Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu soaking treatments, respectively. While, the yield increased by 4.46 and 14.24 % as compared with 3 h soaking duration treatment for 6 and 9 hours soaking duration treatments, respective

The previous results led to conclude that, seeds yield of maize can be increased if seeds soaking in micronutrients solutions before seedling. Also, seeds yield of maize can be increased by increasing seeds soaking duration.

Key words : Maize, yield, yield components ,micronutrients, soaking seeds duration.

INTRODUCTION

Sufficient mineral nutrient reserves in the seed are necessary to maintain seedling growth until root uptake start supplying soil nutrients. This is particularly important for crops grown on soils with low nutrients availability (Asher,1987).

"Nutrient seed priming " is a technique in which seeds are soaking in nutrient solution instead of simple water. Nutrient seed priming increases the seed nutrient contents along with the priming effect to improve seed quality for better germination and seedling establishment. Priming seeds in solutions of macro- or micronutrient has been shown to improve yield of many crops, such as rice, wheat, forage legumes and maize (Peeran and Natanasabapathy, 1980; Wilhelm et al., 1988; Sherrell, 1984 and Imran et al.,2013)

Seed soaking in nutrients can help crop plants to cope with stress factors such as, decrease of nutrients and can increase crop yield (Harris et al., 1999; Harris et al., 2000).

The present study investigates perspectives for seed soaking in water and various micro-nutrients solutions on maize crop under different pre-soaking duration. After establishing and optimizing the soaking conditions, a field experiment was conducted to investigate the effects of seed soaking in four micro-nutrients solutions (Fe, Fe+ Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu) on yield and yield components of maize under three pre-soaking duration (3,6 and 9 hours).

MATERIALS AND METHODS

Micro-nutrients seeds priming:

Micro-nutrients seeds priming is a technique, in which seeds are soaking in mineral micro-nutrients solutions for a particular time duration, dried back to initial moisture contents and stored for further use. Maize seeds were primed for 3,6 and 9 hours by soaking in distilled water and nutrient solutions containing Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu, respectively. Concentration of micro-nutrients in the priming solutions are shown in Table 1. Distilled water-priming seeds were used as control treatment.

Field experiment:

This work was done at the Research station farm, Sebha, Libya during the season of 2010, to study the effect of soaking seeds of micronutrients solution, soaking periods and their interactions on growth, yield and its components of Zea maize plants under sandy conditions (sand 93.9%, Silt 4.0% and clay 2.1%)

The statistical layout of this experiment was split plot design with three replicates. The main plots assigned to soaking periods and the subplot deviated to micronutrient solutions. The experimental included 15 treatments which were the combination of five micronutrient solutions (control, Fe, Fe + Mn, Fe + Mn + Zn and Fe + Mn + Zn + Cu) and three Soaking periods (3, 6, 9 hours). The concentrations and salts used for micronutrients solutions are shown in Table 1.

Table 1: Concentrations and salts used for micro-nutrients maize seeds Priming :

Treatments	Concentrations and salts used
Control	Distilled water primed
Fe	1000 ppm as $FeSO_4$
Fe+Mn	1000 ppm Fe as $FeSO_4$ + 500 ppm Mn as $MnSO_4$
Fe+Mn+Zn	1000 ppm Fe a s$FeSO_4$+ 500 ppm Mn as $MnSO_4$ +100 ppm Zn as $ZnSO_4$
Fe+Mn+Zn+Cu	1000 ppm Fe as $FeSO_4$ + 500 ppm Mn a s$MnSO_4$ +100 ppm Zn as $ZnSO_4$ +50 ppm Cu as $CuSO_4$

The experimental unit area was 10.5 m^2 contained five rows at 50 cm apart at the distance between plants were 30 cm. Each plot contained 70 plants under sprinkler system irrigation. Seeds of maize were sown on 1 st of June 2010.

Plants were thinned to secure one plant per hill, three weeks after planting. All other cultural practices were carried out as recommended for corn crop. The sprinkler irrigation system, was used in the experimental farm.

A random sample of five plants from each replicate were taken at harvest stage and the following data were recorded:

1- plant height (cm).

2- numbers of ears plant^{-1}.
3- numbers of rows ear^{-1}.
4- 100-grain weight (g).
5- grain weight ear^{-1}.
6- shelling percent.
7- Grain yield ha^{-1}.

Grain yield ha^{-1} was determined per each plot then transferred to grain yield (kg ha^{-1}), after modified the moisture content at 15%.

Statistical Analysis:

All collected data were analyzed with analysis of variance (ANOVA) procedures using the MSTAT-C statistical software package (Michigan state university, 1983). Differences between means were compared by LSD at 5% level of significant (Gomez and Gomez, 1984).

Results and Discussion

Data illustrated in Table 2 declared the significant influences of soaking seeds in some micronutrients solutions, soaking durations and their interactions on plant height. Soaking seeds in micronutrients solutions (Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu) increased the mean values of plant height by 10.62, 15.85, 15.06 and 10.38%, respectively as compared with soaking seeds in distilled water. Increasing soaking durations in micronutrients solutions (6 and 9h) increased plant height, the mean values of plant height increased by 4.42 and 8.78%, respectively as compared with 3h soaking duration. This increasing in plant height due to sufficient of micronutrients in the seeds and consequently increase the metabolic mechanisms in the plants to increased plant height by increased cell elongation. The same results was observed by Tahir (1983) and Harris *et al.* (2007).

On the other hand, data illustrated in Tables (2,3 and 4) declared no significant effects for soaking seeds in some micronutrients solutions, soaking duration and their interaction on number of rows/ear, ear length, ear diameter, shelling% and 100-seeds weight.

Data illustrated in Table 5 declared the significant influence of soaking seeds in some micronutrients solutions soaking duration and their interaction on seeds weight/plant as well as seeds weight/hectare. The maize yield increased by 32.98, 40.84, 37.50 and 21.75 % as compared with the control treatment for Fe, Fe+Mn, Fe+Mn+Zn and Fe+Mn+Zn+Cu soaking treatments, respectively. Increasing soaking duration in micronutrients solutions increased seeds weight/hectare, the yield increased by 4.46 and 14.24 % as compared with 3 h soaking duration treatment for 6 and 9 h soaking duration treatments, respectively. Similar results have been reported for maize by Harris *et al.,*(2007) and for soybean by Arif *et al.,* (2007).

Asher (1987) reported that sufficient mineral nutrients reserves in the seeds are necessary to maintain seeding growth until root uptake start supplying soil nutrients. This is particularly important for crop grown on soils with low nutrients availability. Harris *et al.,* (1999) and Harris *et al.,* (2000) reported that seeds soaking in nutrients solutions can help crop to cope with stress factors such as decrease of nutrients and can increase crop yield.

Micronutrients often act as co - factors in enzyme systems and Participate in redox reactions, in addition to having several other vital functions in plants. Most importantly, micronutrients are involved in the key physiological processes of photosynthesis and respiration (Marschner, 1995; Mengel et al., 2001) and their deficiency can impede these vital physiological processes thus limiting yield gain. Micronutrient application through seed treatments improves the stand establishment, advances phenological events, and increases yield and micronutrient grain content in most cases (Farooq et al., 2012).

Priming wheat seeds in Cu solution suppressed seedling emergence (Malh., 2009). In another experiment on Oats seeds priming with Cu had no effect on germination. If any element such as Cu is lacking or not adequately balanced with other nutrients, growth supperession may result (Mengel et al., 2001).

Table (2): Effect of seeds Soaking in some micronutrients solutions , Soaking duration and their interaction on plant height (cm) and number of ear/plant

Micronutrients Soaking Treatments (B) / Soaking duration(h) (A)	Control	Fe	Fe+Mn	Fe+Mn +Zn	Fe+Mn+ Zn +Cu	Mean (A)
	Plant height (cm)					
3	177.00	199.66	197.00	202.33	192.00	193.60
6	185.00	205.33	209.66	206.66	202.33	201.80
9	187.00	202.33	229.33	222.66	211.66	210.60
Mean (B)	183.00	202.44	212.00	210.55	202.00	
L.S.D. at 5%	For (A)= 4.04 For (B) = 5.22 For (A x B) = 9.06					
	Number of rows/ear					
3	12.73	14.90	14.60	16.00	13.93	14.43
6	12.50	15.06	13.73	13.60	12.43	13.46
9	13.56	14.36	14.00	14.26	15.43	14.32
Mean (B)	12.93	14.77	14.11	14.62	13.93	
L.S.D. at 5%	For (A)= NS For (B) = NS For (A x B) = NS					

Table (3): Effect of Seeds Soaking in some micronutrients solutions , Soaking duration and their interaction on ear Length and ear diameter (cm)

Micronutrients Soaking Treatments (B) / Soaking duration(h) (A)	Control	Fe	Fe+Mn	Fe +Mn +Zn	Fe+Mn+ Zn +Cu	Mean (A)
	Ear length (cm)					
3	15.40	17.53	17.60	16.56	17.03	16.82
6	15.96	17.80	17.20	17.40	16.80	17.03
9	18.20	17.10	17.16	17.93	18.00	17.68
Mean (B)	16.52	17.47	17.32	17.30	17.27	
L.S.D. at 5%	For (A)= NS For (B) = NS For (A x B) = NS					
	Ear diameter (cm)					
3	13.70	15.26	15.26	16.00	14.63	14.97
6	14.16	15.30	15.10	14.56	14.93	14.81
9	14.50	15.43	15.10	15.23	15.63	15.18
Mean (B)	14.12	15.33	15.15	15.26	15.06	
L.S.D. at 5%	For (A)= NS For (B) = 0.39 For (A x B) = NS					

Table (4): Effect of seeds Soaking in some micronutrients solutions , Soaking duration and their interaction on shelling (%) and 100-seeds weight (g)

Micronutrients Soaking Treatments (B) / Soaking duration(h) (A)	Control	Fe	Fe+Mn	Fe+Mn +Zn	Fe+Mn +Zn +Cu	Mean (A)
	shelling (%)					
3	80.06	78.30	82.33	77.83	77.36	79.18
6	81.30	81.26	80.43	82.90	78.70	80.92
9	83.30	82.53	80.90	81.86	79.80	81.68
Mean (B)	81.55	80.70	81.22	80.86	78.62	
L.S.D. at 5%	For (A)= NS For (B) = NS For (A x B) = NS					
	100-seeds weight (g)					
3	34.66	34.66	34.66	34.66	34.66	34.66
6	36.00	36.00	36.00	36.00	36.00	36.00
9	38.00	38.00	38.00	38.00	38.00	38.00
Mean (B)	36.22	35.22	40.55	37.11	35.11	
L.S.D. at 5%	For (A)= NS For (B) = NS For (A x B) = NS					

Table (5): Effect of seeds Soaking in some micronutrients solutions , Soaking duration and their interaction on seeds yield per plant (gm) and hectare (kg)

Micronutrients Soaking Treatments (B) / Soaking duration(h) (A)	Control	Fe	Fe+Mn	Fe+Mn +Zn	Fe+Mn +Zn +Cu	Mean (A)
	Seed weight/plant (g)					
3	98.85	123.23	150.38	146.00	121.71	128.03
6	108.28	151.04	143.52	135.90	130.00	133.75
9	115.14	154.28	160.00	161.23	140.66	146.26
Mean (B)	107.42	142.85	151.30	147.71	130.79	
L.S.D. at 5%	For (A)= 1.67 For (B) = 2.15 For (A x B) = 3.73					
	Seed weight/ hectare (kg)					
3	6590	8215	10024	9732	8113	8535
6	7218	10069	9567	9059	8666	8916
9	7675	10285	10666	10748	9377	9750
Mean (B)	7161	9523	10086	9847	8719	
L.S.D. at 5%	For (A)= 227.33 For (B) = 293.49 For (A x B) = 508.36					

تأثير فترات نقع البذور في محاليل بعض العناصر الصغرى على نمو ومحصول الذرة الشامية ومكوناته

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الملخص

إجريت تجربة حقلية بمزرعة مركز البحوث الزراعية – سبها - ليبيا ,خلال الموسم الصيفي 2010 لدراسة مدى استجابة محصول الذرة الشامية ومكوناته لنقع البذور فى محاليل بعض العناصر الصغرى (حديد،حديد +منجيز ،حديد+ منجنيز+ زنك وحديد+منجنيز+زنك+نحاس) تحت ثلاثة فترات نقع مختلفة (3،6 و9 ساعات) . وأشارت النتائج المتحصل عليها إلى :

وجود تأثير معنوي لمعاملات نقع البذور في محاليل بعض العناصر الصغرى و فترات النقع والتفاعل بينهما على كل من ارتفاع النبات ووزن الحبوب (جرام/نبات) ومحصول الذرة (كيلوجرام/هكتار). زاد ارتفاع النبات بنسبة 10.62, 5.85 , 15.06, و 10.38% بالمقارنة بمعاملة النقع فى الماء المقطر لمعاملات نقع البذور في المحاليل المحتوية على الحديد, الحديد + المنجنيز, الحديد + المنجنيز + الزنك والحديد + المنجنيز + الزنك + النحاس على التوالى, بينما زاد ارتفاع النبات بنسبة 4.47 و8.78 % بالمقارنة بمعاملة النقع لمدة 3 ساعات لمعاملتي النقع لمدة 6 و 9 ساعات غلى التوالي. كما زاد المحصول بنسبة 32.98، 40.84، 37.50 و 21.75% بالمقارنة بمعاملة النقع في الماء المقطر لمعاملات نقع البذور في المحاليل المحتوية على الحديد، الحديد+المنجنيز، الحديد+المنجنيز+الزنك والحديد+المنجنيز+الزنك+النحاس، على التوالي, بينما زاد المحصول بنسبة 4.46 و 14.24 % بالمقارنة بمعاملة النقع لمدة 3 ساعات لمعاملتي النقع لمدة 6 و9 ساعات، على التوالي.

كما أوضحت النتائج أنه لا يوجد تأثير معنوي لمعاملات نقع البذور في محاليل بعض العناصر الصغرى و فترات النقع والتفاعل بينهما على كل من عدد الصفوف/الكوز، طول الكوز، نسبة التقشير ووزن 100 بذرة.

من النتائج السابقة يمكن استنتاج أنه يمكن زيادة محصول الذرة إذا تم نقع البذور في محاليل بعض العناصر الصغرى قبل عملية الزراعة وكذلك يمكن زيادة المحصول بزيادة فترات نقع البذور في تلك المحاليل.

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