31 *Egypt. J. Soil Sci.* 44, No.3, pp. 429- 440 (2004)

Effect of Wheat Grains Soaking in some Micronutrient Solutions on Crop Production under Rainfall Condition

T.A. El-Maghraby
Soil, Water and Environment Research Institute, Agriculture Research Center, Cairo, Egypt.

A FIELD experiment was conducted during 2001/2002 growing season at El-Kasr Research Station Farm in Mersa Matrouh. It aimed to study the effect of wheat grains soaking in iron, manganese, zinc and copper solutions on yield and uptake of those elements by straw and grains of wheat plants under rainfall condition. The experiment was conducted with five replicates using complete randomized design. Grains soaking in Fe or Mn or Zn solutions gave greater bioyield of wheat than control (without soaking) and Fe treatment showed superior effect followed by Mn, Zn and Cu treatments. High positive significant effects for soaking wheat grain treatments occurred on straw yield uptake of macronutrients (N and K) and micronutrients (Fe, Mn, Zn and Cu) and on grains yield uptake of macronutrients (N, P and K) and micronutrients (Fe, Mn and Zn). It seems that soaking of wheat grains in micronutrients solutions caused some drought tolerance for growth plant. Soaked wheat grain in micronutrient solutions catch quantities of Mn, Zn and Cu enough to provide growing plants with their needs except iron. Soaking technique for wheat grains in micronutrients solutions was recommended under this condition for its low costs and simple technique.

Keywords: Wheat, Rainfall, Iron, Manganese, Zinc, Copper, Soaking .

Wheat (*Triticum aestivum*) is considered one of the most important winter crops for human and animal demands in Egypt. The main factors effecting wheat productivity in Mediterranean regions and especially in North Africa are water quantity as a function of available water and crop transpiration where the soil evaporation ranged from 20 to 70% of total used water according to Siddique *et al.* (1990), fertilization program (Oweis *et al.*, 1998) and early sowing (Brown *et al.*, 1987).

One of the untraditional methods of fertilization is seed soaking. Khan & Khan (1978) studied the presoaking of wheat grain cv. Pak-70 in Hoagland solution for 4 hr and found more improvement in germination percentage led to pronounced increase in crop yield. The amount of water transpired by a crop may be increased either by reducing soil evaporation. Saric *et al.* (1998) reported that the soaking of wheat grains in distilled water for 24 hr increased quantity of Zn and the yield (root + stem) ranged from 4.4% to 8.2 % compared without seed . Saad *et al.* (1999) reported that soaking of wheat grains in $ZnSO_4$ solution was of high effect on yield. Sallam (1992) found that cultivars (wheat cv. Sakha 8, Sakha 69, Giza 155 and Giza 163) averaged over plant height, fresh and dry weight at the tillering and heading growth stages, also tiller number/plant were highest after in 0.1% $ZnSO_4$. Saraswat and Bansal (1991) showed that the highest rice grains yield was obtained (7.0 and 5.2 t/ha in 1977/78 and 1978/79, respectively) with soaking seedlings in 3% ZnO suspension for 4hr before transplanting and sowing Zn content was higher in the straw than the grain. Migahid & Sadek (1994) found that presoaking in Cu SO_4 had little effect on salt (grown at 0, 25, 50, or 75% seawater concentrations) tolerance of wheat cv. Giza 155. Ibrahim & Shalaby (1994) found that seed soaking in Zn and Cu application increased wheat yield cv. Giza 163 more than the Fe and Mn. Seed soaking in Fe, Zn and Cu significantly increased N in wheat straw and grain and P in wheat grain. The uptake of Fe and Zn in wheat straw and grains significantly augmented by the seed soaking in Fe, Mn and Zn. El-Maghraby (2000) found that soaking wheat seed in Zn-EDTA or Zn- Sulphate (30, 60, and 90mg Zn/L) greater increased the plant weight and Zn-uptake. He found also that soaking wheat seed in Cu-EDTA or Cu-Sulphate greater increased the plant weight and Cu-uptake. The seed soaking was the most economic in terms of actual amounts consumed. Padole (1979) found that soaking wheat grains in $ZnSO_4$, $MnSO_4$ for 4 hr increased the grains yield compared with unsoaked or water soaked grains. Venger *et al.* (1983) reported similar results with solutions of trace elements. Abo-Soliman *et al.* (1992) found that soaking wheat grains in $ZnSO_4$ up to 1600 mg/L resulted in significantly superior grains and straw yields to other served soaking solutions of (K_2SO_4, Na_2 SO_4, Mg Cl_2, Na Cl, Mg SO_4, Mn SO_4, urea and GA_3).

Korosi *et al.* (1986,a) found that manganese was absorbed from the solution (wheat grains were soaked in 0.1, 1.0 or 10 mM solution containing Cu, Mn, Zn and B for 4 – 24hr) in accordance with a saturation curve with a 160% increase in seed Mn concentration after soaking in the 10 mM solution. Retention of Mn during germination was related to the external concentration. Korosi *et al.* (1986,b) showed that accumulation of Mn and Cu by wheat cv. Siete Cerros seedlings were inhibited by increasing trace element; (Mn, Cu and B) concentration in the soaking solution over a concentration range of 0-10mM. The highest trace element accumulation in the shoot occurred when grains were soaked in distilled water prior to sowing. Accumulation of K , which was not a component of the soaking solution, occurred only in the 10 mM solution. Marcar & Graham (1986) found that soaking wheat seed in $MnSO_4$ (giving a Mn content range of 0.1 to 6.4 μ Mn /g seed) prior to sowing greatly increased the grains Mn content, but only about 15 – 20% of this additional Mn was recovered in the seedlings after 26 days growth. Increased grains yields from seed soaking were evident in the field.

The main target of this work was to study the soaking effect of wheat grains on some micronutrient solutions on crop production under rainfall condition.

Material and Methods

A field experiment was carried out on a loamy sand soil during 2001/2002 growing season at El-Kasr Research Station Farm in Mersa Matrouh using wheat plants "*Triticum aestivum*" cv. Sahel 1. Complete randomized design with five replicates for each treatment. Treatments A, B, C, D and E were grains soaked in Fe, Mn, Zn, Cu solutions and unsoaked ones as a control, respectively. Each plot 5 X 5 m^2 received 0.25 kg grains sown 2 cm below soil surface after soaking for 24 hr in solutions of $FeSO_4 . 7H_2O$ (19.5%Fe), $MnSO_4 . H_2O$ (29.0 % Mn), $ZnSO_4.7H_2O$(20.07 % Zn) or $CuSO_4.5H_2O$ (25.17 % Cu).The solutions were prepared to contain 300 mg of an element/L. Plants grow under rainfall condition till maturity, yields of wheat grain and straw for each pot were recorded.

The soil samples taken at the beginning of the experiment were analyzed to define the characteristic properties. Soil particle size distribution without $CaCO_3$ removal using pipette method (Piper, 1950), saturation percent, $CaCO_3$ and organic matter contents were determined according to Black (1965). pH, electric conductivity and soluble ions were determined in soil water paste extract and rain water sample by the methods described by Richards (1954). Available form of macro- and micronutrients N, P, K, Fe, Mn, Zn, and Cu were extracted by ammonium bicarbonate-diethylene triamine penta acetatic acid (NH_4HCO_3-DTPA) and determined after Soltanpour (1985). Table 1 included soil description.

TABLE 1. Soil chemical and physical characteristics of the experimental site.

pH (1:2.5 susp.)	EC (dS/m)	Soluble ions (me/L)							
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
7.87	1.85	4.65	3.30	8.83	0.38	0.00	6.00	7.50	3.66
O.M. (%)	$CaCO_3$ (%)	Available form mg/kg soil							
		P	K	Fe	Mn	Zn	Cu		
1.35	22.91	5.0	545.0	6.0	13.1	4.0	2.6		
Particle size distribution (%)				Texture class				Saturation % (SP)	
C.sand	F.sand	Silt	Clay						
3.1	77.1	17.5	2.3	Loamy sand				25.0	

Plant samples were divided into grains and straw. Dry weights at 70 °C were recorded, ground and digested by mixture of acids wet digestion. Nutrients N, P, K, Fe, Mn, Zn and Cu were determined as described by Chapman and Pratt(1961). The obtained data were statistically analyzed due to Steel & Torrie (1960).

The approximate range of evapotranspiration (ET) for small grain was reported by FAO (1985) between 300 – 450 mm and also the available record of monthly and total precipitation for growth season 2001-2002 at Mersa Matrouh area was reported by weather station are present in Table 2.

TABLE 2. Precipitation and chemical analyses of the rain water.

Month		10/2001	11/01	12/01		1/02	2./02	3/02	Total
Precipitation(mm)		10.1	8.2	27.2		50.5	8.3	0.2	104.5
Soluble ions (me/L)									
Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	pH	SAR	RSC
2.00	1.70	1.00	0.16	2.50	1.50	0.86	7.80	0.74	0.00
Soluble ions (me/L)									
EC(dS/m)		Ca^{++}	Mg^{++}	Na^{+}		K^{+}	HCO_3^{-}	Cl^{-}	$SO_4^{=}$
0.53		40	20	23		6	153	53	41

Results and Discussion

Wheat straw and grains yield

As shown in Table 3, values of grains and straw yields separately or as a total yield indicated that any soaking treatment increased the wheat yield over the control with exception of Cu in case of grains yield. The significant differences were found between the following and control; all soaking treatments in case of straw yield, Fe soaking in case of grains yield, Fe, Mn and Zn soaking treatments in case of total grains and straw yield.

TABLE 3. Effect of soaking treatments on straw, grains, total yields of wheat and harvest index (HI).

Treatments	Straw		Grains		Total		HI (%)
	kg/fed.	Over control (%)	kg/fed.	Over control (%)	kg/fed.	Over control (%)	
Fe	1417.4	27.37	584.6	39.19	2002.0	30.61	29.20
Mn	1419.4	27.55	468.6	11.57	1888.0	23.17	24.82
Zn	1377.0	23.74	456.0	8.57	1833.0	19.59	24.88
Cu	1200.0	7.84	408.0	-2.86	1608.0	4.91	25.37
Control	1112.8		420.0		1532.8		27.40
L.S.D. (at 0.05)	70.1		126.0		143.0		n.s.

Percentage of yield increases over that of control treatment clarified the slope of different soaking treatment effect where the descending order was obtained for straw, grains and total yields as follow:

Fe > Mn > Zn > Cu > control

Harvest index the percentage of grain to total plants indicated that straw was more affected with soaking technique than grain in treatments Mn, Zn, and Cu where HI decreased than that of the control. The opposite was true in case of treatment Fe (Table 3).

Similar results were obtained by Padole (1979); Venger *et al.* (1983) and Abo-Soliman *et al.* (1992). Also, Sallam (1992) and Saad *et al.* (1999) found that soaking of wheat seeds in $ZnSO_4$ solution highly affected the yield.

Macronutrients uptake by wheat straw

The obtained data (Table 4) of macronutrients uptake (NPK) showed a highly positive significant effect for the soaking of wheat grains soaking in micronutrients mineral fertilizer solutions (Fe, Mn, Zn and Cu) in augmenting their N uptake by straw compared with control. This may be attributed to the soaking treatments improve germination percentage and thus increases the crop productivity (Khan & Khan, 1978 and Saric *et al.* 1998).

TABLE 4. Effect of soaking treatments on macronutrients N, P and K uptake by wheat straw in kg/fed.

Macronutrient	Treatments					L.S.D.
	Fe	Mn	Zn	Cu	Control	(at 0.05)
Nitrogen	32.70	35.70	32.96	31.63	26.17	5.34
Phosphorous	2.41	1.99	2.01	1.68	1.67	n.s.
Potassium	22.75	23.20	20.66	18.90	17.53	3.86

However, significant variations between treatments in case of nitrogen uptake indicated that all soaking treatment raised its uptake significantly. The most beneficial treatment resulted from treatment soaking in Mn solution.

As for phosphorous uptake, treatments were found statistically as the same. Iron or zinc treatments showed the two highest values over the control.

Potassium uptake was significantly affected by Fe or Mn soaking treatments only. The obtained data were in agreement by the findings of Korosi *et al.*(1986b) who showed that accumulation of potassium by wheat plant with soaking in 10mM trace element solution (Mn, Cu and B).

Micronutrients uptake by wheat straw

Table 5 clarified that iron uptake of wheat straw was insignificantly affected among all micronutrients soaking treatment, however grains soaking in Fe, Mn and Zn solutions significantly augmented Fe uptake of straw compared with control.

Wheat straw uptake of Mn showed promotive increase for all soaking treatments than control. Although Mn treatment had the highest value for straw Mn uptake there were insignificant differences between all micronutrients soaking treatments.

TABLE 5. Effect of soaking treatments on micronutrients Fe, Mn, Zn and Cu uptake by wheat straw in g/fed.

Micronutrient	Treatments					L.S.D.
	Fe	Mn	Zn	Cu	Control	(at 0.05)
Iron	694.53	695.13	619.26	579.20	462.93	141.34
Manganese	76.54	85.12	79.12	76.80	62.32	8.87
Zinc	80.79	73.77	71.03	66.00	53.41	9.99
Copper	31.18	29.79	25.63	21.60	21.14	5.41

Zinc uptake of wheat straw showed significant differences of all soaking treatments against control. On the other hand, there were insignificant differences between Fe, Mn and Zn soaking treatments. Differences between Mn, Zn and Cu soaking treatments were insignificant; the difference between Fe and Cu treatments was significant.

The highest copper uptakes of wheat straw were for Fe and Mn treatments, also an insignificant effect between these two treatments was obtained. It was clear also that there was no significant effect among treatments of Zn, Cu and control. Copper treatment showed significant lower values for straw uptake of Cu than Fe and Mn treatments.

Macronutrients uptake by wheat grain

The differences in nitrogen grains uptake between treatments of Zn, Cu and control were insignificant as cleared in Table 6. On the other hand, N uptake among all soaking treatments was significant except between Zn and Cu treatments, the difference was insignificant.

TABLE 6. Effect of soaking treatments on macronutrients N, P and K uptake by wheat grain in kg/fed.

Macronutrient	Treatments					L.S.D.
	Fe	Mn	Zn	Cu	Control	(at 0.05)
Nitrogen	22.51	18.67	14.71	16.07	15.34	2.67
Phosphorous	3.63	2.61	1.96	2.27	1.81	0.96
Potassium	4.27	3.62	3.36	3.06	2.87	0.58

Phosphorous uptake of wheat grain was significantly higher for Fe soaking treatment than the other three treatments and control. Similar findings were obtained by Ibrahim & Shalaby (1994). They found that seed soaking in Fe, Zn and Cu significantly increased N and P in wheat (straw and grain) and grain, respectively. Moreover, insignificant differences for P uptake among the treatments of Mn, Zn, Cu and control were obtained.

About potassium uptake of wheat grains, there were promotive and significant increases for Fe and Mn soaking treatments than control. The significant average increase of potassium uptake by grains with soaking in Fe and Mn solution were 1.40 and 0.75 kg/fed., respectively, compared with the control (Table 6) . In addition, K uptake of wheat grain was significantly higher for Fe soaking treatment than the other three treatments, but the difference between Mn and Zn was insignificant as between Zn and Cu treatments.

Micronutrients uptake by wheat grain

Table 7 cleared that Fe, Mn and Zn uptake of wheat grains gave significant increases for major soaking treatments than control. This was in agreement with Marcar and Graham (1986) found that soaking wheat seed in $MnSO_4$ greatly increased the grains Mn content. Although Mn treatment had maximum value of grains uptake of Fe, the difference between Fe and Mn treatments was insignificant. On the other hand, the differences among Fe, Zn and Cu treatments were insignificant. Data also showed a highly significant effect for the soaking in Fe or Mn or Zn solutions in augmenting its iron uptake by grain compared with control, the significant increase of Fe-uptake was 56.93, 95.42, 42.31 g/fed. for Fe, Mn and Zn solutions ,respectively. But, seed soaking in copper solution and control were statistically similar in Fe, showed the most effective in augmenting the Fe-uptake, where the lowest values were observed with soaking in Zn, Cu and control.

TABLE 7. Effect of soaking treatments on micronutrients Fe, Mn, Zn and Cu uptake by wheat grains in g/fed.

Micronutrient	Treatments					L.S.D.
	Fe	Mn	Zn	Cu	Control	(at 0.05)
Iron	110.63	149.12	96.01	90.69	53.70	39.17
Manganese	30.79	28.08	26.65	24.99	19.09	4.92
Zinc	78.61	62.88	72.07	64.80	38.81	26.29
Copper	14.43	13.13	8.49	9.51	8.65	n.s.

Manganese uptake values by wheat grain were insignificant among the three treatments of Fe, Mn and Zn and also the same result between Zn and Cu treatments. The significant average increase of Mn-uptake with soaking in Fe, Mn, Zn and Cu solution was 11.70, 8.99, 7.56 and 5.90 g/fed., respectively, over control. Although the highest Zn uptake value was for Fe treatment, but Mn, Cu and control treatments were similar. The significant average increase of Zn uptake with soaking in Fe and Zn solution was 39.8 and 33.26 g/fed. respectively, over control, similar results were reported by Ibrahim & Shalaby(1994). ANOVA of Cu uptake showed insignificant effect between all treatments and control.

Soaking treatment as a source of micronutrients

Table 8 contained sowing grains soaking uptake of micronutrients g/fed., due to soaking treatments, without soaking (initial) and the increase percent of values than initial. All calculation values in this table considered sowing grains was 40 kg/fed.

TABLE 8. **Sowing grains soaking* uptake of micronutrients g/fed., due to soaking treatments, without soaking (initial) and the increase percent of values than initial.**

	Fe	Mn	Zn	Cu
Sowing grains uptake of micronutrients g/fed. (After soaking).	117.17	102.37	152.09	181.13
Sowing grains uptake of micronutrients g/fed. (Without soaking).	53.13	11.55	27.19	6.32
Increase of micronutrients uptake of sowing grains soaking g/fed. due to soaking.	64.04	90.82	124.90	174.81
Increase % of micronutrients uptake of sowing grains soaking g/fed. due to soaking.	20.53	686.32	359.36	2665.98

* Sowing grains was 40 kg/fed.

As shown in Table 8, the sowing grains soaking uptake of micronutrients g/fed., due to soaking was 117.17, 102.37, 152.09 and 181.13 for Fe uptake under Fe treatment, Mn uptake under Mn treatment, Zn uptake under Zn treatment and Cu uptake under Cu treatment, respectively. The values showed descending order as follows:

Cu > Zn > Fe > Mn

On the other hand, sowing grains uptake values of micronutrients g/fed., without soaking (initial) was 53.13, 11.55, 27.19 and 6.32 for Fe, Mn, Zn and Cu, respectively. The order of the micronutrients initial uptake was as follows:

Fe > Zn > Mn > Cu

It was clear also that the increase percent values of micronutrients uptake of sowing grains g/fed. due to soaking was 20.53, 686.32, 359.36 and 3675.98% for Fe uptake under Fe treatment, Mn uptake under Mn treatment, Zn uptake under Zn treatment and Cu uptake under Cu treatment respectively, i.e. An example for Mn , increase % value= ((102.37 – 11.55)/11.55) X 100 = 686.32%.

The order of the increase percent values was as follows:

Cu > Mn > Zn > Fe

It was clear from Table 8 and the data of micro nutrients content of straw and grains, (Tables 5 & 7) that, except iron and manganese nutrients, the soaking of wheat grains in mineral micronutrients solutions, catch enough quantity of zinc and copper for all growth requirements, *i.e.*, example of Zn:

* Total straw content of Zn was 71.03 g/fed. Table 5, and total grain content of Zn was 72.07 g/fed.(Table 7) .
* Total plants content of Zn = 71.03 + 72.07 = 143.10 g/fed.
* Sowing grains soaking content of Zn g/fed. after soaking was152.09g/fed. (Table 8).

About Mn, there was no big difference between values of (straw+grain) content g/fed. and sowing grains soaking content of Mn g/fed. after soaking, the values were 113.20 and 102.37 for (straw + grain) content g/fed. and sowing grains soaking content of Mn g/fed. after soaking, respectively.

The soil provides the plant with its requirements of available iron in addition to the soaking grains content of Fe. This behavior was due to the high plant needs of Fe as shown from Fe plant content data compared with another three micronutrients.

This data were in agreement with Korosi *et al.* (1986,b) found that Mn was absorbed from the solution containing Cu, Mn, Zn and B for 4-24 hr, with a 160 % increase in seed Mn concentration after soaking.

Conclusion

From the mentioned results and discussion it could be concluded that:

* All soaking treatments increased wheat straw and grain yields significantly with exception of Cu treatment in case of grain yield.
* Uptake of N, K, Fe, Mn, Zn and Cu by straw were of positive significant responses to soaking treatments as well as the uptake of N, P, K, Fe, Mn and Zn by grains
* Available micronutrients in soil and caught quantities of micronutrients after grain soaking in mineral micronutrients solutions, supplied the plant with its needs of micronutrients for growth.
* Generally, it could be recommended with soaking technique for wheat which under this condition is reliable because of its low cost and simplicity.

References

Abo-Soliman, M.S.M.; Kaoud, E.E., and Ahmed A.R. (1992) Effect of soaking wheat grains soaking in various solutions on yield. *Egypt. J. Soil Sci.* **32**,1.

Black, C.A. (1965) *"Methods of Soil Analysis"*, Part 2. Chemical and Microbiological Properties, Agronomy no. 9, Amer. Soc. of Agron., Madison, Wis.

Brown, S.C.; Keatinge, J.D.H.; Gregory, P.J. and Cooper, P.J.M. (1987) Effects of fertilizer, variety and location on barley production under rainfed conditions in Northern Syria.1. Root and shoot growth. *Field Crops Res.* **16**, 53.

Chapman, H. D. and Pratt, P.F. (1961) Methods of Analysis for Soils, Plants, and Waters. Division of Agricultural Sciences, University of California, Davis.

El-Maghraby, T.A. (2000) Evaluation of some techniques of fertilization with phosphorous fertilizer and some trace element fertilizers. *Ph.D. Thesis,* Fac. of Agric., Moshtohor, Zagazig Univ., Benha Branch, Egypt.

FAO (1985) Water quality for agriculture. *FAO Irrigation and Drainage Bull.* **29**, Rome.

Ibrahim, M.E. and Shalaby, M.H. (1994) Effect of some micronutrients and methods of their application on growth, yield and mineral composition of wheat. *Annals of Agric. Sci. Moshtohor* **32** (3), 1371.

Khan, M. A. and Khan, M. I. (1978) Ionic and osmotic effects of sodium chloride on germantion rate and subsequent growth of wheat seedlings. *Pakistan J. Bot.* **10** (1), 101.

Korosi, F.; Andras, L. and Patzay, G. (1986a) Microelement treatment of wheat (Siete Ceros). I- Effect of microelement soaking on enrichment of seed as well as on leaching of nutrient elements during the soaking and germination. *Bulletin of the University of Agric. Sci. Godollo.* **1,** 59.

Korosi, F.; Andras, L. and Patzay, G. (1986b) Microelement treatment of wheat (Siete Ceros) grains soaking. II. Effect of microelement soaking on manganese, copper and potassium content of wheat seedlings. *Bulletin of the University of Agric. Sci. Godollo.***1,** 69.

Marcar, N. E. and Graham, R.D. (1986) Effect of seed manganese content on the growth of wheat (*Triticum aestivum*) under manganese deficiency. *Plant and Soil* **96** (2), 165.

Migahid, M. M. and Sadek, L. A. (1994) Effect of pre-soakng with trace elements on salt tolerance of three cultivars of wheat. Alex. *J. Agric. Research* **39** (3), 501.

Oweis, T.Y.; Pala, M. and Ryan, J. (1998) Stabilizing rain-fed wheat yields with supplemental irrigation and nitrogen in a Mediterranean-type climate. *Agron. J.* (In press).

Padole, V.R. (1979) Effect of Pre-soaking seed treatment of wheat seed with chemicals and hormones on yield and uptake of NPK. *J. Maharashatra Agric. Univ.* **4**(1), 85.

Piper, C. S. (1950) *"Soil and Plant Analysis"*, Inter. Sci. Publ. Inc., New York, USA.

Richards, L. A. (1954) *"Diagnosis and Improvement of Saline and Alkaline Soils"*, U.S. Dept. of Agric., Handbook No. 60, USA.

Saad, F.F.; Shaban, S.A. and Said, A. (1999) Response of some cereal crops to presowing hardening treatments under saline conditions. *Assiut J. Agric. Sci.* **30** (1), 43.

Sallam, H.A. (1992) Zinc seed-hardening of some wheat cultivars in relation to growth behaviour and some biochemical constituents under saline conditions. *Annals of Agric. Sci., Moshtohor* **30**(3), 1249.

Saraswat, V.K. and Bansal, K.N. (1991) Methods of zinc application and its effect on yield and zinc content of rice (*Orzya sativa*) and wheat (*Triticum vulgare*). *Madras Agric. J.* **78,** 5.

Saric, M.; Filipovic, N.; Hladni, N. and Grujic, O. (1998) Production and use of sprouting wheat grains soaking as a biologically valuable food. *Acta-Alimentaria-Budapest* **27** (1), 21.

Siddique, K.H.M.; Tennant, D., Perry, M.W. and Belfford, R. K. (1990) Water use and water use efficiency of old and modern wheat cultivars in a Mediterranean- type environment. *Aust. J.Agric. Res.* **41**,431.

Soltanpour, P. N. (1985) Use of ammonium bicarbonate DTPA. Soil test to evaluate elemental availability and toxicity. *Soil Sci. Plant Anal.* **16** (3), 323.

Steel, R.G. D. and Torrie, J. H. (1960) *"Principles and Procedures of Statistics"*, Mc Graw- Hill, New York.

Venger, S.S.; Surkov, V.A. and Nigal, V. P. (1983) Effect of pre-sowing treatment of wheat seed with solutions of mineral fertilizers on protein contents in the apical cone of a tiller and on morphogenesis (*c.f. Soils and Fert.* **46,** 1.)

(*Received* 10/2002)

تأثير نقع حبوب القمح فى بعض محاليل أسمدة العناصر الصغرى على انتاجية المحصول تحت ظروف المطر

طه عبد الخالق المغربى
معهد بحوث الأراضى و المياه والبيئه - مركز البحوث الزراعية-القاهرة - مصر.

أجرى هذا البحث بمحطة بحوث القصر – مرسى مطروح خلال الموسم الزراعى ٢٠٠١/ ٢٠٠٢ بهدف دراسة تأثير نقع حبوب القمح (ساحل ١) فى محاليل أسمدة كل من الحديد و المنجنيز والزنك و النحاس بالإضافة الى الكنترول وذلك على المحصول وامتصاص هذه العناصر تحت الظروف الممطرة.وقد استخدم تصميم تام العشوائيه بخمس مكررات فى تنفيذ التجربة ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلى:-

١. زاد المحصول البيولوجى وذلك بنقع حبوب القمح قبل الزراعة فى محاليل كل من الحديد أو المنجنيز أو الزنك بالمقارنة بالكنترول (عدم نقع) بينما نقع الحبوب فى محلول الحديد أعطت تأثير متفوق بالمقارنة بالنقع فى محاليل الزنك أو النحاس.

٢. أدت معاملات النقع جميعها إلى زيادة فى إمتصاص النيروجين فى القش أما النقع فىمحاليل الحديد أو المنجنيز أدت إلى زيادةإمتصاص البوتاسيوم فى القش.

٣. أدت معاملات النقع فى محاليل الحديد أو المنجنيز أو الزنك الى زيادة إمتصاص الحديد فى القش بالمقارنة بالكنترول أما إمتصاص المنجنيز زاد فى جمع معاملات النقع وكذلك إمتصاص الزنك كان مختلف معنويا فيما بين جمع المعاملات . ولكن إمتصاص النحاس أعطى أعلى قيمة فى حالة النقع فى الحديد أو المنجنيز .

٤. أدت جميع معاملات النقع الى زيادة امتصاص النتروجين فى الحبوب بينما امتصاص الفوسفور فى الحبوب كان فى حالة نقع الحبوب فى محلول الحديد ولكن امتصاص البوتاسيم فى الحبوب زاد فى حالة نقع الحبوب فى محاليل كلا من الحديد أو المنجنيز.

٥. زاد امتصاص الحديد والمنجنيز فى حالة النقع فى محاليل الحديد أو المنجنيز أو الزنك بالمقارنة بالكنترول بالرغم زيادة فى امتصاص الزنك فى حالة النقع فى محلول الحديد.

٦. تعتبر طريقة النقع أقل تكلفة وتقنية بسيطة وفى نفس الوقت إقتصادية.

٧. أدت طريقة النقع فى المحاليل العناصر الصغرى الى امداد النبات بالقدر الكافى لإحتياج النبات من عنصرالحديد و المنجنيز والزنك والنحاس بالاضافة الى الصورة الميسرة فى التربة من هذه العناصر.