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RESPONSE OF WHEAT AND ITS COMPONENTS TO IRON AND ZINC UNDER DIFFERENT METHODS OF APPLICATION IN SANDY SOILS

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ABSTRACT

Two field experiments were conducted at Ismailia Agricultural Research Station during two successive seasons 2002/2003 and 2003/2004 to evaluate the effect of Fe, Zn and their mixture applied by different methods as grains coating, grains soaking, foliar spray and soil application on wheat yield and grain quality in sandy soils.

Irrespective of the application methods, the obtained data revealed that grains and straw yields and the investigated yield attributes as well as grain protein, K, Fe and Zn contents were significantly increased by the studied micronutrients application. The highest values were induced by application of Zn singly or in combination with Fe treatments. Grain phosphorus content was not significantly affected by application of the studied micronutrients.

Grain coating method with Zn and / or Fe had beneficial effects on wheat production and its quality compared to the other application methods, as the following order: grains coating > foliar spray > soil application > grains soaking. On the other hand, methods of application had no significant effects on straw yield. grain P and K contents.

INTRODUCTION

In Egypt, great attention has been done for increasing of wheat crop per unit area. Extensive researches have become an urgent necessity to increase its production and improve its quality.

Application of micronutrients is an important factor to improve wheat crop and its grain quality. It is worth to noting that the Egyptian soils are suffering from deficiencies of some micronutrients, especially in sandy and calcareous sandy soils. The most deficient micronutrients are Zn, Mn and Fe (El-Fouly *et al.*, 1984). The efficiencies of micronutrients fertilization are mainly dependent on the time and methods of application.

Foliar spray of wheat with micronutrients is commonly used under Egyptian conditions, it was found to have a positive effect on yield and its components by many investigators. El-Awady and Abdel-Naim (1990) obtained the highest yield of wheat by double foliar application of 0.4 % Zn as $ZnSO_4$ at tillering and booting stages. Also, Dahdoh (1997) reported that the highest grain yield was obtained by foliar application of 0.5 % Fe + 0.25 % Cu or 0.5 % Zn + 0.5 % Mn (each as sulphate form). Foliar application of Fe, Zn and Mn significantly increased grains and straw yields of wheat plants (Abdel-Hadi *et al.* 1987 and 1990, Hassan *et al.* 1992 and Mousa *et al.* (1994).

Chemical composition of grains and straw yield of wheat plants was also affected by micronutrients application. Sayed *et al.* (1984) found that, foliar application of Fe, Mn, Zn and Cu increased the grain yield of wheat plants and the uptake of N, P, K, Ca, Mg, Zn, Mn, Fe and Cu contents either in grain or shoot system. While, Negm and Zahran (2001) found that foliar application of Fe, Zn and Mn as a mixture at booting or tillering stages increased wheat grains and straw yields and its components as well as grain protein and potassium contents, whereas, grain contents of P, Fe, Zn and Mn were not significantly affected by micronutrients application.

In Pakistan, the response of wheat plants to the addition of micronutrients as soil application was also studied by several workers, Chaudhary *et al.* (2001), Mian *et al* (2001), Kaya *et al.* (2002) and Salarzai and Bajaw (2002) who found that yield and yield components of wheat crop were affected substantially with soil application of zinc sulphate except plant height and straw yield.

Khan and Jamil (1998) found that the addition of Zn, Cu and Fe as soil application alone or in combination significantly increased the contents of Zn, Cu and Fe in wheat plants. On rice crop, a comparative effect of three different methods of zinc application (soaking, spraying and soil application) was studied by Khan *et al.* (2003a and 2003b) who found that yield, yield components, N, K and Zn of paddy and straw were significantly increased over control irrespective of application methods. He added that, soil application of Zn was superior to the other treatments.

Recently, additional methods of application have been developed including seeds coating by micronutrients compounds. Shinlnkov (1987) stated that seed treatment with micronutrients before sowing is a very valuable procedure for supplying micronutrients.

Ghaly *et al.* (1991) found that corn grain yield was markedly increased with increasing the amount of coating Zn, Mn and Fe alone up to the rate of 0.3 g of each element per one kg of seeds. While, Eissa *et al.* (1995) revealed that application of mixture containing Zn, Mn and Fe as seeds coating of wheat crop grown on sandy soils, significantly increased plant height, grain yield and 1000 grain weight as well as Zn, Mn, Fe and protein contents in wheat grains.

The aim of the present study was to investigate the effect of Fe and Zn chelates applied singly or in combination as grains coating, grains soaking, foliar spray and soil application on wheat production in sandy soils.

MATERIAL AND METHODS

Two field experiments were conducted during 2002/2003 and 2003/2004 growing seasons at Ismailia Agricultural Research Station, representing sandy soils, to study the response of wheat crop to some micronutrients chelates i.e. Fe and Zn individually as well as its combination by using different methods of application as grains coating, grains soaking, foliar spray and soil application and their effect on wheat grains and straw yields as well as some chemical contents of grains.

Wheat variety (Giza 168) was sown at the rate of 60 kg / fed. in rows, 20 cm apart at the end of November in both seasons under sprinkler irrigation system.

Representative soil samples (0-30 cm) were taken before performance of the experiment. Some characteristics of soil samples were determined according to the methods described by Chapman and Pratt (1961), Jackson (1973) and Soltanpour (1985) as shown in Table (1).

Split plot design with four replicates was used. The area of each plot was 10.5 m^2. The main plot was the kind of micronutrient; Fe and Zn-EDTA applied alone or in combination, and one treatment as control (without micronutrients). The sub-plot included methods of application.

Table 1: Some chemical characteristics of the experimental soil.

Soil properties	1st season	2nd season
EC mmohs/cm (1 : 5 ext.)	0.25	0.33
pH (1 : 2.5 susp.)	7.38	7.51
Available N* (ppm)	36.24	42.07
Available P* (ppm)	3.16	2.74
Available K* (ppm)	43.22	48.63
Available Fe* (ppm)	1.26	1.42
Available Zn* (ppm)	0.17	0.23
Available Mn** (ppm)	1.58	1.37
Available Cu** (ppm)	0.82	0.93

* Low level ** Adequate level (Soltanpour ,1985)

Grains and plants were treated as follows using chelate forms of micronutrient and Triton-B material as a spreader agent:

I- Grains coating treatments.

1-Control (grains were pre-treated with Triton-B only).
2-Grains coating with 0.3 g Fe / kg grains (6% Fe-EDTA).
3-Grains coating with 0.3 g Zn / kg grains (14% Zn-EDTA).
4-Grains coating with 0.3 g Fe + 0.3 g Zn / kg grains (as a mixture).

II- Grains soaking treatment.

1-Control (grains soaking in water).
2-Grains soaking in 0.3 g Fe / L (6% Fe-EDTA).
3-Grains soaking in 0.3 g Zn / L (14% Zn-EDTA).
4-Grains soaking in 0.3 g Fe + 0.3 g Zn / L (as a mixture).

III- Foliar spray treatments.

1-Control (spraying with 0.5 ml Triton-B / L).
2-Foliar spray with 0.3 g Fe / L (6% Fe-EDTA).
3-Foliar spray with 0.3 g Zn / L (14% Zn-EDTA).
4-Foliar spray with 0.3 g Fe + 0.3 g Zn / L (as a mixture).

IV- Soil application treatments.

1-Control (without micronutrients application)
2-Addition of 2 kg Fe-EDTA (6%Fe)/fed.
3-Addition of 1 kg Zn-EDTA (14%Zn)/fed
4-Addition of 2 kg Fe + 1 kg Zn-EDTA/fed. (as a mixture).

Grains of wheat were soaked in Fe and/or Zn-solution as pre-treatments to full cover the grains for 6 hours. Wheat plants were received two foliar spray of micronutrients, 45 and 60 days after sowing, the volume of spray solution was 400 L/fed. using Triton-B as a surfactant agent (0.5 ml/l). Grains coating and soil application of micronutrients treatments were carried out just before planting. All experimental plots received 30 kg P_2O_5 as super-phosphate (15 % P_2O_5) and 24 kg K_2O as potassium sulphate (48% K_2O) as recommended rates before sowing. Nitrogen fertilizer was added at the rate of 100 kg N/fed. as ammonium sulphate (20.6%N) in five equal doses, starting from sowing and every two weeks.

At harvesting, grains and straw yields of each plot were weighted, then were estimated as ardab/fed. and ton/fed., respectively. Some yield attributes i.e. plant height (cm), spike length (cm) and 1000 grain weight (g) were recorded. Composite grains samples were taken, dried at 70 °C, ground and 0.5 g of sample was subjected to wet ashing. Aliquots were taken for N determination using the micro-kjeldahl method as described by A.O.A.C. (1970), then multiplied by 5.7 to obtain protein percentage. Phosphorus was determined colourimeterically and potassium was estimated by flame-photometer according to Jackson (1973). Fe and Zn in grains were estimated by Atomic Absorption Spectrophotometer. Data were subjected to statistical analysis according to Snedecor and Cochran (1971).

RESULTS AND DISCUSSION

Grains and straw yields:

Data presented in Table (2) showed that grains and straw yields of wheat plants were significantly positive responded to micronutrients application during the two seasons, the mean increment percentages of grains yield (mean of two seasons) were 15, 23 and 24 while they were 15, 35 and 26 for the straw yield compared to the control treatment due to Fe, Zn and (Fe + Zn) treatments, respectively. Irrespective of the methods of application, the highest grains yield was obtained with the mixture of (Fe + Zn) treatments. While, the highest value of straw yield was observed when Zn treatment was added, the differences between the two treatments due to grains and straw yields were not significant. These increases could be explained on the basis of soil analysis, which showed that the availability levels of Fe and Zn (as ppm in soil) are considered lower than the critical level reported by Soltanpour (1985). Similar results were obtained by Abdel-Hadi *et al.* (1990), Hassan *et al.* (1992), Mousa et *al.* (1994) and Negm *et al.* (2001) on wheat crop and Khan *et al.* (2003a) on rice crop. Concerning the micronutrients applied by different methods, the obtained data in Table (2) clearly showed that the grains coating method was superior to the other application methods as regard to wheat grains yield, followed by foliar spray treatment. However, the difference between them was not significant during the two growing seasons. This may be due to that grains coating method provides the wheat seedling with important micronutrients under study in its critical time of development. In this regard, Eissa *et al* (1995) revealed that

application of Zn, Mn and Fe as seed coating of wheat crop grown in sandy soils, significantly increased grain yield and its components. Also, Kausar and Rashid (1999) found that application of Zn either as ZnO or $ZnSO_4$ at the time of sowing is recommended for wheat.

Table 2. Grains and straw yields of wheat as affected by some micronutrients application methods during 2002 /2003 and 2003 /2004 seasons.

Treatment		Grains yield (ardab/fed.)			Straw yield (ton/fed.)		
Micronutrient	Method of application	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	Coating	6.22	7 40	6.81	4.03	3.26	3.65
	Soaking	6.18	7.97	7.08	3.30	3.46	3.38
	Spraying	6.44	7.32	6.88	3.71	3.94	3.83
	Soil application	5.83	8.18	7.01	3.56	3.69	3.63
	Mean	6.17	7.72	6.95	3.65	3.59	3.62
Fe	Coating	8.11	9.04	8.58	4.23	4.39	4.31
	Soaking	7.49	7.46	7.48	3.82	3.90	3.86
	Spraying	7.89	8.45	8.17	4.45	4.25	4.35
	Soil application	7.74	7.92	7.83	4.38	3.83	4.11
	Mean	7.81	8.22	8.02	4.22	4.09	4.16
Zn	Coating	8 73	9.87	9.20	4.96	522	5.09
	Soaking	7.88	8.14	8.01	4.25	4.64	4.45
	Spraying	8.07	9.22	8.65	4.72	5 65	5.19
	Soil application	8.02	8.65	8.34	4.69	4.94	4.82
	Mean	8 22	8.97	8.55	4.66	5.12	4.89
Fe + Zn	Coating	8.24	10 02	9.13	4.38	5.05	4.72
	Soaking	7.95	8.27	8.11	3.97	4.33	4.15
	Spraying	8.17	8 78	8.48	4.64	4.90	4.77
	Soil application	8.02	9.37	8.70	4.43	4.81	4.62
	Mean	8.08	9.11	8.61	4.36	4.77	4.57
Mean of application Method	Coating	7.93	9.08	8.51	4.40	4.48	4.44
	Soaking	7.37	7.96	7.67	3.84	4.08	3.96
	Spraying	7.64	8.44	8.04	4.38	4.69	4.54
	Soil application	7.44	8.53	7.99	4.27	4.32	4.30
L.S.D at 0.05 for:							
Micronutrient (A)		0.36	0.48		0.52	0.86	
Method of application (B)		0.24	0 29		N.S	N.S	
(A) x (B)		0.49	0.67		N.S	N.S	

Yield attributes:

Data in table (3) indicated that application of studied micronutrients with different methods significantly increased the yield components of wheat plants; i.e. plant height, spike length and 1000-grain weight during the two growing seasons compared with the control treatment. Zn treatment gave higher mean values than those obtained with the other treatments, the average relative increments of plant height, spike length and 1000-grain weight were 9, 21 and 7%; while they were 6, 19 and 6% due to the addition of (Fe + Zn) treatment, respectively. The relative increases in yield components over control treatment were obtained irrespective of the application methods. Grains coating with Zn and /or Fe treatments gave the highest 1000-grain weight than the other methods during both seasons; while

plant height and spike length were affected positively in the 2nd season only. This could be due to the available Zn in soil was insufficient (0.17 and 0.23 ppm) and its application was very important for plant growth and yield production. Moreover, the efficiency of Zn and /or Fe treatments was more pronounced under application them as grains coating method. On the other hand, the metabolic function of Fe in plant in connected in some manner with the supply of Zn (Olsen, 1977). Similar results were obtained by Eissa *et al* (1995), Negm *et al* (2001) and Kaya *et al* (2002).

Table 3. Yield attributes of wheat as affected by some micronutrients application methods during 2002 /2003 and 2003 /2004 seasons.

Treatment		Plant height (cm)			Spike length (cm)			1000 grain weight (g)		
Micro-nutrient	Method of application	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean
control	Coating	71.6	73.9	72.8	7.42	7.58	7.50	41.07	42.05	41.56
	Soaking	73.4	70.6	72.0	7.63	7.26	7.45	40.63	40.10	40.37
	Spraying	71.9	72.7	72.3	7.59	7.65	7.62	40.24	42.57	41.41
	S.appli.*	72.1	73.4	72.8	7.38	7.47	7.43	41.37	40.92	41 15
	Mean	72.3	72.7	72.5	7.51	7.49	7.50	40.83	41.41	41.12
Fe	Coating	76.3	78.3	77.3	8.44	8.53	8.49	42.42	43.33	42.88
	Soaking	75.5	71.9	73.7	8.26	8.02	8.14	41.74	43.15	42.45
	Spraying	74.1	76 9	75.5	9.03	8.62	8.83	42.15	44.33	43.24
	S.appli *	74.6	72.1	73.4	8.34	8.38	8.36	41.92	41.67	41.80
	Mean	75.1	74.8	75.0	8.52	8.39	8.46	42.06	43.12	42.59
Zn	Coating	81.9	83.1	82.5	9.93	9.55	9.94	45.39	44.29	44.84
	Soaking	76.6	74.9	75.8	8.87	8.43	8.65	43.05	43.86	43.46
	Spraying	80.1	81.4	80.8	9.15	9.20	9.18	43.55	45.13	44.34
	S.appli.*	76.9	77 3	77.1	9.08	8.63	8.86	42.94	42 32	42.63
	Mean	78.9	79.2	79.1	9.26	8.95	9.11	43.73	43.90	43.82
Fe+Zn	Coating	77 1	80.6	78.9	9.46	9.16	9 31	43.86	45.86	44.86
	Soaking	75.6	74.5	75.1	8.93	8.47	8.70	42.43	42.00	42 22
	Spraying	75 3	80.2	77 8	9.22	9.03	9.13	44.27	45.28	44.78
	S appli *	73 8	77 9	75 9	8 86	8.46	8.66	43.35	43.06	43.21
	Mean	75.5	78.3	76.9	9.12	8.78	8.95	43.48	44.05	43.77
Mean of appli. method	Coating	76.7	79 0	77.9	8.81	8.71	8.76	43.19	43.88	43.54
	Soaking	75.3	73 0	74.2	8.42	8.05	8.24	41.96	42.28	42.12
	Spraying	75.4	77 8	76.6	8.75	8.63	8.69	42.55	44.33	43.44
	S.appli.*	74 4	75 2	74.8	8.42	8.24	8.33	42.40	41.99	42.20
L.S.D at 0.05 for:										
Micronutrient (A)		2.6	1.9		0.55	0.37		0.94	0.68	
Method of appli. (B)		N.S	1.3		N.S	0.25		0.61	0 49	
(A) x (B)		3.3	2 4		0.68	0.49		1.02	1.16	

* S.appli. = Soil application

Grain contents of protein, phosphorus and potassium:

Data presented in Table (4) clearly indicated that, application of Fe, Zn and their mixture significantly increased grain protein content over the control treatment irrespective of the application methods, the mean relative increases during the two seasons were; 34, 46 and 44%, respectively. These increases in grain protein could be due to the important function of Fe and Zn for the enzymes of amino acid synthesis in protein formation. In this connection, Polykarpochkia and khavkin (1972) reported that Zn deficiency

inhibited the growth of roots and leaves of maize plants and inhibited the protein synthesis and the accumulation of the majority of free amino acids. Moreover, Amberger (1974) mentioned that the amount of protein in Fe deficiency leaves is lower but the total concentration of free amino acids is much higher than that in the control. Also, Zn is necessary for RNA and protein synthesis.

Table 4. Grain contents of protein, P and K as affected by some micronutrients application methods during 2002 /2003 and 2003 /2004 seasons.

Treatment		Protein %			Phosphorus %			Potassium %		
Micro-nutrient	Method of application	1st season	2nd season	Mean	1st season	2nd season	Mean	1st season	2nd season	Mean
control	Coating	8.29	8.87	8.58	0.328	0.355	0.342	0.97	1.01	0.99
	Soaking	8.14	8.65	8.40	0.317	0.371	0.344	1.03	0.84	0.94
	Spraying	8.43	8.06	8 70	0.370	0.362	0.366	0.92	0.95	0.94
	S.appli.*	7.45	8.41	7.93	0.352	0.344	0.348	0.95	0.89	0.92
	Mean	8.08	8.73	8.41	0.342	0.358	0.350	0.97	0.92	0.95
Fe	Coating	10.87	12.07	11.47	0.366	0.368	0.367	1.71	1.77	1.74
	Soaking	10.75	11.47	11.12	0.384	0.352	0.368	1.49	1.28	1.39
	Spraying	10.83	11.96	11.39	0.397	0.359	0.378	1.58	1.56	1.57
	S.appli.*	10 95	11.03	10.99	0.375	0.341	0.358	1.52	1.47	1.50
	Mean	10.85	11.63	11.24	0.381	0.355	0.368	1.58	1.52	1.55
Zn	Coating	12.65	13.32	12.99	0 415	0.428	0.422	1.85	1.88	1.87
	Soaking	11.35	12.17	11.76	0.392	0.410	0.401	1.57	1.67	1.62
	Spraying	12.11	12.78	12.45	0 409	0.396	0.403	1.66	1.78	1.72
	S.appli.*	11.47	12.51	11.99	0 388	0.418	0.403	1.68	1.59	1 64
	Mean	11.89	12.70	12.30	0.401	0.413	0.407	1.69	1.73	1.71
Fe+Zn	Coating	12.43	13.01	12.72	0.433	0 431	0.432	1 82	1.88	1.85
	Soaking	10 70	12 40	11.56	0.386	0.399	0.393	1.54	1.70	1.62
	Spraying	11 64	13.01	12.33	0.429	0.413	0.421	1.77	1.74	1.76
	S appli.*	11 24	12.20	11.72	0.364	0.421	0.393	1.57	1 69	1.63
	Mean	11.50	12 66	12.08	0.403	0.416	0.410	1.68	1.75	1.72
Mean of appli method	Coating	11 06	11 82	11 44	0 386	0.396	0 391	1.59	1 63	1 61
	Soaking	10.23	11 17	10 70	0 370	0.383	0.377	1 41	1.37	1.39
	Spraying	10 75	11 68	11 22	0.401	0 383	0.392	1 48	1 51	1.50
	S appli *	10 28	11.04	10.66	0 370	0.381	0.376	1.43	1 41	1 42
L S D at 0.05 for.										
Micronutrient (A)		0 85	0 93		N.S	N.S		0.55	0.48	
Method of appli (B)		0.61	0.48		N.S	N.S		N.S	N.S	
(A) x (B)		1.13	0.96		N.S	N.S		N.S	N.S	

*** S. appli. = Soil application**

Regarding the methods of application, it was noticed that grains coating method was superior to the other ones, followed by foliar application method, especially with Zn alone or in combination with Fe. These findings were in agreement with those obtained by Abdel-Hadi *et al* (1990), Hassan *et al* (1992) and Negm and Zahran (2001) who found that the grain protein content responded positively to the addition of Zn, Mn and Fe.

On the other hand, phosphorus content in wheat grains was not significantly affected by application of Fe and /or Zn, whereas grain potassium content was significantly positive responded regardless the methods of application. These results agree with those obtained by El-Kadi *et*

al (1975), Negm and Zahran (2001) on wheat and Khan *et al* (2003b) on rice crop.

Grain content of Fe and Zn:

As for Fe and Zn concentrations in wheat grain, the obtained data in Table (5) indicated that grain content of Fe was significantly increased by application of Fe, Zn and their mixture treatments regardless the methods of application, the average relative increments over the control treatment were; 26, 11 and 18 %, respectively. The least value of Fe in wheat grains was obtained by the addition of Zn treatment. This could be due to the antagonistic effects between Fe and Zn (Tandon, 1989).

Table 5. Grain contents of Fe and Zn as affected by some micronutrients application methods during 2002 /2003 and 2003 /2004 seasons.

Treatment		Fe (ppm)			Zn (ppm)		
Micronutrient	Method of application	1st season	2nd season	Mean	1st season	2nd season	Mean
Control	Coating	283.8	273.2	278.5	29.3	31.6	30.5
	Soaking	290.2	275.2	282.7	24.1	29.7	26.9
	Spraying	288.7	280.3	284.5	25.8	31.4	28.6
	Soil application	285.1	268.7	276.9	27.4	29.4	28.4
	Mean	287.0	274.4	280.7	26.7	30.5	28.6
Fe	Coating	357.4	397.4	377.4	35.8	43.9	39.9
	Soaking	344.2	328.1	336.2	32.7	39.7	36.2
	Spraying	335.5	371.4	353.5	33.5	42.8	38.2
	Soil application	339.7	348.3	344.0	35.2	40.1	37.7
	Mean	344.2	361.3	352.8	34.3	41.6	38.0
Zn	Coating	328.6	326.4	327.5	58.7	68.6	63.7
	Soaking	315.0	287.7	301.4	40.2	56.7	48.5
	Spraying	320.6	314.4	317.5	42.9	64.1	53.5
	Soil application	310.3	294.8	302.6	45.1	60.2	52.7
	Mean	318.6	305.8	312.2	46.7	62.4	54.6
Fe + Zn	Coating	347.2	358.7	353.0	47.9	58.6	53.3
	Soaking	317.7	320.4	319.1	42.2	49.4	45.8
	Spraying	325.4	334.6	330.0	45.6	54.8	50.2
	Soil application	323.8	327.1	325.5	39.5	50.4	45.0
	Mean	328.5	335.2	331.9	43.8	53.3	48.6
Mean of application Method	Coating	329.3	338.9	334.1	42.9	50.7	46.8
	Soaking	316.8	302.8	309.8	34.8	43.9	39.4
	Spraying	317.6	325.2	321.4	37.0	48.3	42.7
	Soil application	314.7	309.7	312.2	36.8	45.0	40.9
L.S.D at 0.05 for:							
Micronutrient (A)		12.7	14.4		6.2	8.6	
Method of application (B)		7.9	9.8		4.4	5.1	
(A) x (B)		19.3	23.3		9.9	13.2	

Zn content of wheat grains was recorded the highest significant increments due to the addition of Fe, Zn and their mixture. On the mean of two seasons, the relative increments over control were 33, 91 and 70%, respectively. Application of Fe treatment has less effect on Zn content of grains.

Regarding the application methods of micronutrients, it was noticed that, the grain coating method was more effective than the other treatments; especially with Zn alone or in mixture with Fe. Similar results were obtained by Abdel-Hadi *et al* (1984) on soybean, Chaudhary *et al* (2001) on wheat crop and Khan *et al* (2003b) on rice crop. Who found that application of Zn either as soil application or foliar spry increased Fe and Zn contents in rice grains.

Moreover, Eissa *et al* (1995) mentioned that, the application of Zn, Mn, Fe and B as seeds coating treatments significantly increased wheat yield and grain nutrients contents.

From economical point of view, it could be concluded that the application of Zn alone or in combination with Fe as grains coating method is superior to the other methods of application in producing high quantity and quality yield of wheat grown under sandy soils conditions.

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إستجابة محصول القمح ومكوناته للطرق المختلفة لإضافة الحديد والزنك فى الأراضى الرملية

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أقيمت تجربتان حقليتان فى محطة البحوث الزراعية بالإسماعيلية خلال موسمى الزراعة ٢٠٠٢/٢٠٠٣ ، ٢٠٠٣/٢٠٠٤ وذلك لتقييم تأثير إضافة الحديد والزنك وكذا مخلوط هذه العناصر بطرق الإضافة الممكنة والتى تشمل طريقة تغليف التقاوى أو نقعها فى محلول العناصر أو الرش الخضرى بها هذا بجانب الإضافة الأرضية لها على إنتاجية القمح وصفاته المحصولية تحت ظروف الأراضى الرملية.

وقد أظهرت النتائج المتحصل عليها أثناء موسمى الزراعة أن إضافة العناصر الصغرى تحت الدراسة، قد أحدثت زيادة معنوية فى محصول الحبوب والقش ومكوناته المحصولية، وكذلك محتوى البذور من البروتين والبوتاسيوم والحديد والزنك، بينما لم يتأثر محتوى الحبوب من الفوسفور معنويا بإضافة العناصر موضوع الدراسة.

وقد أظهرت الدراسة أيضا أن طريقة تغليف التقاوى بعنصر الزنك مع او بدون عنصر الحديد أعطت افضل النتائج على محصول القمح وصفاته النوعية وذلك بالمقارنة بطرق الإضافة الأخرى. ويمكن ترتيب طرق إضافة العناصر طبقا لتأثيرها على محصول القمح على النحو التالى: طريقة تغليف التقاوى > الرش الخضرى > الإضافة الأرضية > نقع التقاوى فى محلول العناصر. هذا ولم يكن لطريقة الإضافة بالعناصر تحت الدراسة أى تأثير معنوى على محصول القش أو محتوى الحبوب من الفوسفور والبوتاسيوم.