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IMPACT OF SEED COATING WITH MINERAL OR CHLEATED FORMS OF IRON AND ZINC ON WHEAT YIELD

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ABSTRACT : A field experiment was conducted at the farm of Ali Moubark, El-Tahreer South. Agric. Res. Center during the growing season of 2005/2006 to study the effect of coating seeds with Fe and Zn on wheat plants (*Triticum aestivurn, L.*). Fe and Zn were applied using seed coating method individually at rates of 0.3 and 0.6 g/kg seed respectively, in nonchelate and chelating forms.The mean results could be summarized as follows:

1- Grains, straw and biological yields were positively affected by the application of Fe and Zn in both nonchelated or chelated form. Maximum responses were observed under Fe and Zn addition in chelating form followed by the nonchelated ones.

2- Application of the Fe and Zn caused significant increases in Fe and Zn contents in both grains and straw, especially with chelating form.

3- Nitrogen, phosphorus and potassium contents in both grains and straw of coated seeds were significantly increased under various micronutrient treatments. The chelating form was superior compared to the other treatments.

Key Words: Coating seeds, Iron and Zinc and wheat yield

INTRODUCTION

Wheat is one of the most important cereal crops in Egypt; such crop is known to be highly responsive to some micronutrients.

In recent years, some researchers reported that application of micronutrients to plants grown on some soils of Egypt gave better growth and more yield (Thalooth *et al.*, 1981; El-Gayar *et al.*, 1988; Waly,

1996 and El-Shikha, 2004). Micronutrients effect directly or indirectly on photosynthesis, respiration and synthosis. Eissa *et al.*, 1992), Rashid and Fox (1992) and Nassar *et al.*, (2002) stated that the rates of photochemical reactions and activities of the carboxylation enzymes, i.e. phosphocenol pyruvic (PEP), catoxylase, ribulose biphosphate (RBP) as well as carbonic anhydrase were increased by the application of Zn, Mn, Fe, B, Mo and Cu in a descending order, compared with the control. Application of micronutrients significantly increased yield components, as well as seeds and straw yields. Wally (1996) on pea found that there was a competitive effect for Zn-application on Fe-content. However, Hassan (1996) and Nassar (1997) on wheat hinted to the positive effect of Zn on Fe-uptake. Moreover, Nassar *et at.* (2002) found that the application of some micronutrients (Fe, Zn, Mn and their interaction) caused an increase in N, P, K and some micronutrients uptake in seed and straw of broads bean.

The aim of this work is to shade some light on the impact seed coating with Fe and Zn applied in chelated and nonchelated forms on the yield and nutrients contents of grains and straw of wheat plant.

MATERIALS AND METHODS

A field experiment was carried out at south Tahrir Agric. Res. Station, Agric. Res. Center, Ali Moubark Village El-Bustan region, Behira governorate during the growing season of 2005/2006 to study the impact of coating wheat seed (chelated with Fe and Zn) with nonchelated form on the yield and grains mineral contents of wheat grown on sandy soil. Some physical and chemical characteristics of the investigated soil are shown in Table 1.

Wheat (*Triticum aestivum, L.*) seeds variety Sakha 69 were sown at the rate of 55 kg/fed in rows, 20 cm apart. Each plot was 3.0m wide and 3.5 m in length (3.0 x 3.5m). A randomized complete block design with three replicates was used. All the plots received N, P and K fertilizers before sowing at the rate of 15 kg N/fed, 13.2 kg P/fed, and 19.92 kg K/fed,. The remainder of N fertilizer (90 kg N/fed) added in three equal doses at 15 days intervals starting from 15 days after sowing. Whereas, Fe and Zn forms as mineral or chelate were fertilized by seed coating

Table 1a. Some physical and chemical characteristics of soil used during 2005/2006 winter season.

Partical size distribution			Soil texture	pH 1: 2.5	E.C. ds/m	O.M. (%)	$CaCO_3$ (%)
Sand (%)	Silt (%)	Clay (%)					
90.50	5.99	3.51	Sandy	8.50	0.71	0.16	4.65

Table 1 b. Fertility status of the studied soil

Available nutrients (mg/kg^{-1})						
N	P	K	Fe	Zn	Mn	Cu
21.3	2.1	67.4	0.77	0.13	0.29	0.08

method. Coating treatments were carried out before planting, hence seeds were coated with Fe and Zn as mineral or chelated at rates of 0.3 and 0.6 gm/kg, respectively. Seeds were first damped with a solution of a sticker substance Triton-B (0.5 ml/L) and mixed with the chelated substance for tested micronutrients. Then, the coated seeds were air dried until just before sowing. A control treatment (without micronutrients) was also taken into consideration.

Wheat seeds were sown in rows on 15th November, 2005 growing season. At harvesting straw and grains yield/fed were recorded. Some yield components, i.e. biological yield and grain/straw ratio were also recorded.

From each plot, samples of grains and straw were dried, ground and wet digested using H_2SO_4 HC_1O_4 acid mixture. In the digested product, nitrogen was determined by micro-kjeldahl method described by A.O.A.C. (1970). Phosphorus and potassium were determined as described by Chapman and Pratt 1961). Micronutrients contents, namely Fe, Zn, Mn and Cu were estimated by the atomic absorption spectrophotometer (Model GBC90) as described by Chapman and Pratt (1961).

Data were statistically analyzed where LSD at 5% level of significance was used for comparison between the means of different treatments, Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Grain, Straw and Biological Yields of Wheat Plant as Affected By Seed Coating with Mineral and Chelated Forms of Fe and Zn.

Data in Table 2 show that Fe and Zn applied in different rates in both mineral and chelating forms achieved highly significant increases in grains, straw and biological yields compared with the untreated one. Nonetheless there were no signification differences between the treatments under this investigation.

The positive effects of the micronutrients under this investigation on both grains and straw can be explained as follows : a) Fe and Zn are nvolved directly or indirectly in the formation of starch, protein and other biological components in wheat grains through their role in the respiratory and photosynthesis mechanisms, beside their roles in affecting activity of various enzymes (Monged *et al.*, 1993). b) These micronutrients play an important role in stimulating the vegetative growth through increasing cell size and leaf area. Thus, the rate of photosynthesis increases (Mahmoud *et al.*, 1987 and El-Shikha, 2004). c) Wheat is more sensitive to Fe or Zn deficiency than any cereal crop and the favorable effect of Fe or Zn could be attributed to their low content in the experimental soil (Table 1) or to the important function of them in plant metabolism since they participates in photosynthesis and chloroplast development. There are also very important role of Fe and Zn, hence some enzymes containing them such as ascorbic acid oxidase cytocro-meoxidase and polyphenoloxidase act in plant respiration and proteins biosynthesis (Amberger.. 1974). On the other hand, Grains, straw and biological yield were significant increases affected by Fe or Zn addition in chelating form whilst their increments were recorded when they applied as mineral coating of seed. The enhancing effect of the investigated elements as chelating on the grains and straw may be attributed to changes induced by these nutrients in these nutrients in the endogenous hormone ratios (Szirtes *et al.*, 1986 and Ibrahim and Shalaby, 1994).

In this respect, Nassar *et al.* (2002) showed that the increase of both grains and straw yields of

Table 2. Grain, straw and biological yields of wheat as affected by seed coating with mineral and cheated forms of Fe and Zn

Form	Element	Rate	Grains yield *ardab/fed	Straw yield ton/fed	Biological yield ton/fed	Grains /straw ratio
	Control	0	10.41	7.24	8.80	0.22
Mineral	Fe	0.3	10.90	7.67	9.31	0.21
		0.6	10.93	7.66	9.30	0.21
	Zn	0.3	13.99	7.53	9.63	0.28
		0.6	13.03	8.26	10.21	0.24
Chelated	Fe	0.3	13.87	9.41	11.49	0.22
		0.6	12.99	9.22	11.17	0.21
	Zn	0.3	16.00	9.94	12.34	0.24
		0.6	14.53	9.18	11.36	0.24

LSD (5%)		
Forms	1.78	0.58
Elements	1.70	n.s
Rates	n.s	n.s
Forms x Elements	1.67	1.22
Rates x Forms	1.62	0.68
Rate x Forms	1.20	n.s
Forms x Elements x Forms	1.50	n.s

* Ardab = 150 kg

wheat may be due to these elements which enable the plants to grow well and to improve the transfer of the photosynthetic substances from leaves to grains during the synthesis processes because of their effects on the enzymatic groups.

When the grains to straw ratio was considered, the differences between the treatments were pronounced as shown in Table 2. This is probably due to the bases of the role of micronutrients under study in both vegetative and reproductive stages.

In this connection, Baders *et al.* (1996) reported that the role of specific micronutrients in prolonging the vegetative stage was accompanied by a competition between vegetative and reproductive growth.

Macronutrients Content in Wheat Plant as Affected By Seed Coating with Different Forms of Fe and Zn

Slight increases in grains or straw N, P and K content of grains and straw were detected due to the addition of the iron and zinc as mineral or chelating (Table 3). N, P and K content in both grains and straw of wheat significantly increased with the addition of Fe and Zn as mineral or chelating and its rate.

The synergistic effects of these elements on macronutrients uptake can be attributed to the following reasons:

a) Play an important roles in assimilation processes e.g. proteins and nucleic acids synthesis, (Delvin and Withman. 1983).

b) They are considered as essential components of various enzymes necessary for metabolic mechanisms (Vallee and Wacker. 1973).

c) Trace elements under investigation play an important role in the assimilation processes of organic and inorganic phosphorus compounds i.e. phospholipids, phosphoproteins and phosphocarbohydrates.

Table 3. Macrocnutrients content (kg/fed) in wheat plant as affected by seed coating with mineral and chelated forms of Fe and Zn

Form	Element	Rate	Nitrogen		Phosphorus		potassium	
			Grains	Straw	Grains	Straw	Grains	Straw
	Control	0	26.08	57.43	5.15	6.50	5.62	120.82
Mineral	Fe	0.3	39.51	108.14	5.72	6.90	5.72	156.46
		0.6	36.06	135.58	6.06	5.36	5.73	188.43
	Zn	0.3	48.68	52.93	7.76	8.86	7.97	132.04
		0.6	38.89	45.43	7.62	6.60	7.52	138.76
Chelated	Fe	0.3	41.66	79.04	8.74	8.46	8.11	193.84
		0.6	41.66	94.04	8.60	8.29	7.60	197.50
	Zn	0.3	47.68	76.53	10.96	6.95	10.20	209.73
		0.6	38.35	66.13	8.06	6.43	7.84	163.50
LSD (5%) :								
Forms			1.80	5.72	0.80	n.s	0.32	15.78
Elements			1.50	5.12	1.12	n.s	0.87	5.07
Rates			3.46	n.s	0.56	0.39	0.81	n.s
Forms x Elements			2.60	7.26	n.s	0.48	n.s	7.18
Rates x Forms			2.50	n.s	0.78	n.s	n.s	11.25
Rates x Forms			4.90	8.68	0.78	0.55	n.s	11.25
Form. x Elements x Forms			3.50	3.10	0.77	0.42	0.88	n.s

Concerning grains and straw, macronutrients content gave the greatest value under the addition of Fe or Zn as chelating. Moreover, this superior effect may be due to the suitable balance between the forementioned micronutrients, which enable the plants to grow well and to absorb more quantities of NPK.

The statistical analyses indicates that in most cases significant differences between the individual treatments compared with each of the other ones or between the dual treatments. However, significant differences between the dual and individual treatment as well as between the triple treatment and the other ones were registered. In this respect, Waly (1996) on Pea and Nassar (1997) on wheat found that the addition of micronutrients simultaneously gives an additional enhancing effect on NPK contents.

Micronutrients Content in Wheat Plant as Affected By Seed Coating with Mineral and Chelated Forms of Fe and Zn

Data in Table 4 revealed that, all investigated micronutrient increased the uptake of Fe, Zn, Mn and Cu in the both of grains and straw of wheat plant compared with the control treatment.

It is evident from Table 4 that the effect of treatments under investigation on micronutrients uptake was more pronounced in straw than in grains.

The highest increments in Fe, Zn, Mn and Cu uptake in grains and straw were observed under the treatment of micronutrients chelating; at both of the addition rates (0.3 and 0.6). In addition, a significant increment in micronutrients content in grains and straw of wheat plant was observed. There were significant differences between the element.

The above mentioned results can be explained on the basis of raising the corresponding values of both grains and straw yields. Wheat seed coating with Fe or Zn promotes the proliferation of roots and leads the plants to grow well. Consequently, plant roots absorb more nutrients and collect the suitable requirements of Fe and Zn. These results are in harmony with those obtained by Osman et al. (1991) on faba bean, Hassan (1996) and Nassar (1997) on wheat, Nassar *et al.* (2002) on faba bean and El- Shikha (2004) on rice.

From the foregoing results it can be concluded that seed coating

with micronutrients as chelating has a positive effect on the quantity and quality of wheat yield. In this connection, application of Fe and Zn led to the highest values of yield and yield components of wheat as well as macro and micronutrients content, followed by Fe and Zn as mineral coating of seeds, respectively.

The greatest response of wheat plants to Fe and Zn as coating means that the amount of Fe or Zn in the soil under study are not sufficient to face the requirements of wheat plants from these nutrients.

Table 4. Micronutrients content in wheat plant as affected by seed coating with mineral and chelated forms of Fe and Zn.

Form	Element	Rate	Fe content kg/fed		Micronutrients Content (g/fed)					
					Zn		Mn		Cu	
			Grains	Straw	Grains	Straw	Grains	Straw	Grains	Straw
Mineral	Control	0	0.168	1.820	21.86	94.05	20.29	108.52	6.71	50.65
	Fe	0.3	0.299	2.247	35.30	130.39	23.37	115.05	11.93	85.29
		0.6	0.318	2.681	37.70	111.83	27.05	124.85	11.47	55.91
	Zn	0.3	0.369	2.113	53.51	201.25	36.72	140.88	13.22	76.48
		0.6	0.371	2.519	56.68	235.41	30.29	137.11	12.70	68.55
Chelated	Fe	0.3	0.482	4.469	42.65	141.15	27.67	150.56	17.26	103.51
		0.6	0.492	5.190	38.97	104.18	27.27	180.71	13.63	76.52
	Zn	0.3	0.571	3.280	57.37	149.10	48.45	194.82	12.75	79.52
		0.6	0.542	4.344	58.84	165.33	33.78	148.71	11.98	73.48
LSD (5%):										
Forms			0.48	0.24	n.s	11.47	3.48	7.18	1.43	3.04
Elements			0.05	0.11	7.11	5.17	4.92	7.01	n.s	n.s
Rates			0.40	0.27	3.30	n.s	2.60	n.s	0.98	3.44
Forms x Elements			0.52	0.16	5.20	7.32	n.s	n.s	2.57	4.29
Rates x Forms			0.36	n.s	3.85	11.50	3.68	n.s	1.85	4.88
Rates x Forms			0.42	n.s	4.20	11.50	3.68	10.24	2.50	4.88
Rates x Elements x Forms			0.44	n.s	5.36	8.60	3.50	14.49	2.50	6.90

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تأثير تغليف التقاوي بالحديد والزنك في الصورة المعدنية والمخلبية علي محصول القمح

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أقيمت تجربة حقلية خلال موسم ٢٠٠٥/٢٠٠٦ بمحطة بحوث جنوب التحرير (قرية على مبارك – منطقة البستان- محافظة البحيرة) لدراسة تأثير تغليف تقاوي القمح بالصورة المعدنية والمخلبية لعنصري الحديد والزنك على محصولي الحبوب والقش ومحتواهما من العناصر الغذائية الكبرى والصغرى.

غلفت تقاوي القمح(صنف سخا ٦٩) قبل الزراعة بعناصر الحديد والزنك فى الصورتين المعدنية والمخلبية بمعدلين ٠,٣، ٠,٦ جم عنصر/ كجم تقاوي

وقد أشارت النتائج المتحصل عليها الى النقاط الآتية :

١- كان هناك تأثير ايجابي على كلاً من محصولي الحبوب والقش والمحصول البيولوجي نتيجة إضافة الصورة المعدنية أو المخلبية لكلاً من الزنك والحديد وكانت الاستجابة العظمى مع الصورة المخلبية لكلا من العنصرين تحت الدراسة.

٢- زاد محتوي النيتروجين والفوسفور والبوتاسيوم فى كلاً من الحبوب والقش زيادة معنوية نتيجة المعاملة بالحديد و الزنك فى الصورة المخلبية.

٣- أدت إضافة الحديد والزنك إلى زيادة معنوية فى محتوى هذه العناصر فى كلا من الحبوب والقش خاصة مع الصورة المخلبية.