THE EFFECT OF ZN, MN AND FE BY COATING MEHTOD ON WHEAT YIELD GROWN IN CERTAIN SOILS OF EGYPT

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Abstract

Three field experiments were conducted to study the effct of Zn , Mn and Fe nutrients by the coating method on wheat grown on sandy calcareous and alluvial soils . Three rates of each element; 0.15, 0.30 and 0.60 g /Kg grain were used compared with the control . Obtained data of yield components and flag leaf analysis are summatized as follows :

wheat yield was markedly affected by increasing the amount of coating Zn, Mn and Fe up to the rate of 0.30 g of each element . The percentage of wheat yield increase using Zn-application was found to be 13.7 % , 14 . 7 % and 15 . 6 % over the control for the sandy , calcareous and alluvial soils , respectively. Corresponding increase of Fe application was 15.2 % , 22.2 % and 11.8 % over the control . Application of Mn at the rate of 0.15 g / kg grain gave a similar effect by nearly 13 % over the contrlol for the different soils used.

The response of straw yield to manurial treatments nearly followed the same trend of wheat grain.

Superior protein yield of wheat grain was obtained by Mn application, followed by Fe and Zn treatments.

Analysis of flag leaf taken at the booting stage indicated that N, P, K, Zn, Mn and Fe concentrations were also affected.

INTRODUCTION

Wheat production is considered one of the most essential crops in Egypt. Shortage in the production of such crop is generallly considered one of the most economic and social problems. Therefore, the total cultivated area as well as the total grain production are of utmost imoprtance.

At present, efforts are devoted to increase food and agricultural production , mainly through the increase in cultivated area and also through efficient use of fertilizers. In certain soils, micronutrients may become a limiting factor in crop production, particularly in newly reclaimed areas, especially sandy and calcareous soils.

At present, about 150.000 feddans are being prepared for rain fed wheat cultivation at Sinai (sandy soil) and the North Western coast of the Nile Delta.

Micronutrients application through the coating method was found to be the most suitable method under the scarecity of irrigation water.

The present investigation aimed at studying the effect of Zn , Mn and Fe. application by the coating method on wheat production grown on sandy, calcareous and alluvial soils of Egypt.

MATERIALS AND METHODS

The experimental work was conducted at Ismailia and Nubaria at Northern Tahreer and at Gemmiza at the Middle Delta (Agricultural Research Stations).

The soil characteristics are demonstrated in the following Table:

Characters	Ismailia	Nubaria	Gemmeiza
Soil texture	sandy	Calcareous	Clay loam
pH	7.9	8.11	8.54
E.C. mmbos /cm 25°C	1.32	1.59	1.45
Available N	25 ppm	28 ppm	70 ppm
Available P	5.6 ppm	4.5 ppm	8 ppm
Available K	280 ppm	300 ppm	415 ppm
DTPA extractable :			
Zn	0.8 ppm	1.0 ppm	1.3 ppm
Mn	4.0 ppm	6.0 ppm	7.5 ppm
Fe	6.0 ppm	5.4 ppm	9.0 ppm

The levels of available Zn, Mn and Fe in the soils under study were determine-by DTPA extraction (Lindsay and Norvell, 1969).

Three levels of each of Zn , Mn and Fe (0.15 , 0.30 and 0.60 g) element / one kg of grain were used compared with the control in Complete Randomized blocks with 6-replicates. Zn and Mn were applied in the form of EDTA compounds and Fe was applied in the form of EDDHA compound . Triton B material was used as a spreader on wheat grain surface.

Fertilization treatment consisted of N as ammonium sulphate , P_2O_5 as superphosphate and K_2O as potassium sulphate at the rate of 70 , 30 and 34 kg / feddan , respectively. Nitrogeneous and potassium fertilizers were added into two doses after 21 and 32 days from planting , whereas superphosphate was applied before planting.

Flag leaf samples were taken from the plants at the booting stage and were prepared for the detetrmination of Zn, Mn and Fe according to Jackson (1985). Nitrogen was determined by the semi - micro Kjeldahl method . Phosphorus was determined colorimeterically according to Chapman (1962). Potassium was determined by flame photometry according to Jackson (1958).

Yield components of wheat representing weight of grain as ardab/feddan, straw yield as ton / feddan and protein yield as Kg/ feddan were determined.

RESULTS AND DISSCUSSION

1- Yield components

1a. Grain yield

The present work is considered as a preliminary study that must be followed by several other attempts to futher studies that are to examine the effect of added Zn, Mn and Fe with differernt combination rates on the production of different varieties of wheat. The results given in Table 1 show the effect of differernt manurial treatments of Zn, Mn and Fe chelate by the coating method on the production of wheat growm on sandy, calcareous and alluvial soils. Application of Zn , Mn and Fe chelate induced much grain production. The percentage increase in grain yield as affected by 0.3 g Zn / kg grain was found to be 13.7 % , 14 .7 % and 15.6 % over the control for the sandy , calcareous and alluvial soils , respectively. Moreover, the highest Zn rate (0.6 g) produced 15. 6 % increase over the control for the sandy soil . Application of Mn at the rate of 0.15 g / kg grain gave a similar effect by nearly 13 % over the contol for the different soils used. When Fe was applied at the rate of 0.3 g, increases in grain production were 15.2 %, 22.2 % and 11.8 % over the control for the sandy, calcareous and alluvial soils, respectively. Moreover, the highest Fe rate (0.6 g) produced and increase of 20.4 % with the sandy soils.

The lower content of available Zn , Mn and Fe in the sandy and calcarreous soils as compared with that found in alluvial soils could explain the higher response of wheat grain to the highest Zn an Fe concentrations.

These results clearly indicate that the application of Zn , Mn and Fe by the coating method is very effective with regard to wheat production on sandy , calcareous and alluvial soils of Egypt.

1b. Straw yield

Regarding the straw yield of wheat (ton / feddan), data presented in Table 1 indicate that the different manurial treatments markedly affected the straw yield in the different locations. Effect of Zn , Mn and Fe by the coating method on straw yield followed almost the same trend of grain yield.

Table 1 . The effect of Zn , Mn and Fe nutrients by the coating method on the yield component of wheat grown on certain soils of Egypt.

Treatments (g / kg grain)			Sandy soil			Calcareous soil			Alluvial soil		
Zn	Mn	Fe	Grain Ardab / (feddan)	Straw Ton / (feddan)	Protein Kg (feddan)	Grain Ardab / (feddan)	Straw Ton / (feddan)	Protein Kg (feddan)	Grain Ardab / (feddan)	Straw Ton / (feddan)	Protein Kg (feddan)
Conrol			7.44	2.12	1562	7.71	2.31	1556	15.88	3.35	4764
0.15	-	-	9.39*	2.27	1674	7.97	2.61	1594	17.26	3.40	5178
0.30	-	-	8.94	2.32	2122*	8.84*	2.77*	2043*	18.35*	3.94*	5780*
0.60	-	-	8.60*	2.54*	2211*	8.19	2.86*	2122*	17.29	3.33	6224*
-	0.15	-	8.43*	2.22	1829	8.71*	2.75*	1877	17.98*	3.77*	5394
-	0.30	-	8.61*	2.54*	3221*	8.26	2.62	2316	16.55	3.46	6703*
-	0.60	-	8.03	2.38	1937*	8.07	2.65	1950	16.09	3.26	4827
-	-	0.15	7.77	2.47*	1800	9.23*	2.57	2217*	16.99	3.41	5607
-	-	0.30	8.57*	2.64*	2967*	9.42*	2.74*	2530*	17.75*	3.76*	6390*
-	-	0.60	8.96	2.45	1872*	8.32	2.56	2224*	16.00	3.56	5760*
$\bar{X}$			8.33	2.40	2120	8.47	2.63	2042	17.01	3.52	5663
L.S.D	5%		0.71	0.34	307	0.79	0.37	468	1.78	0.41	950

1c. Protein yield

Data presented in Table 1 clearly show the total protein yield of wheat (kg / feddan) grown on sandy, calcareous and alluvial soils. Application of Zn at the two higher rates (0.3 g and 0.6 g) increased total protein yield with 35. 9 % and 41.5 % over the control for the sandy soils, respectively. Corresponding increase was 31.3 % and 35.7 % for the calcareous 21.3 % and 30.6 % for alluvial soils respecively. Roy *et al.,* (1981). reported that Zn is recognized as an essential component of a number of dehydrogenases and peptidases. Superior protein yield of wheat was found when Mn treatment was applied at the rate of 0.3 g. Increase in protein yield was 106.2 % , 48.8 % and 40. 7% over the control for the sandy, calcareous and alluvial soils, respectively. Highest Mn rate (0.6 g) produced 24% increase over the control for sandy soils. This result may be due to the role of manganese in nitrate reduction, where manganese acrs as an activator for enzyme nitate reductase (Jian 1983) .

Application of Fe by the coating method at the rate of 0.3 g and 0.6 g / kg grain did affect protein yield of wheat thoughout the different locations used. The percentage increases of total protein were 89.9 % and 19.8 % over the control for the sandy soils , respecively. Corresponding increases were 62.6 % and 42.9 %, 34.1 % and 20.9 % for calcareous and alluvial soils. Many investigators reported that iron has several important roles in the metabolism of the plant, that and lack of iron may inhibit the formation of chloroplast, through inhibition of protein synthesis (Hewitt 1963; Devlin and Withman 1983).

2 - Plant analysis

Results of plant analysis given in Table 2 show the effect of different treatments on macro and micro - nutrients contents of the flag leaf samples taken at the booting stage from the three experiments. It is clearly shown that for the three elements Zn, Mn and Fe, lower concentations were not detected for samples taken from sandy and calcareous soils. Compared with the alluvial soil. It had been reported that values of 11 -20 ppm for Zn , 11 - 15 ppm for Mn and 20 -100 ppm for Fe are considered low, whereas values of 21 - 40 pm, 16 -100 ppm and 101 - 150 ppm for Zn , Mn and Fe, resectively were considered as normal . In the present invesigation, Zn, Mn and Fe concentrations were found to be relatively low in sandy and calcareous soils, and this may explain the higher response of wheat to Zn , Mn and Fe application by the coating method as compared to the results of the alluvial experiment.

Table 2. The effect of Zn, Mn and Fe nutrients by the coating method on the flag leaf analysis at the booting stage of wheat grown in certain soils of Egypt.

Treatments (g / Kg grain)			N	P	K	Zn	Mn	Fe
Zn	Mn	Fe	%	%	%	ppm	ppm	ppm
			Sandy soil					
Conrol			4.34	0.215	1.23	15	10	80
0.15	-	-	5.10	0.187	1.23	20	10	120
0.30	-	-	4.30	0.190	1.25	25	15	140
0.60	-	-	3.90	0.220	1.30	30	20	100
-	0.15	-	4.22	0.204	1.30	30	20	100
-	0.30	-	4.60	0.236	1.34	30	25	80
-	0.60	-	5.40	0.295	1.39	20	25	60
-	-	0.15	3.60	0.266	1.27	20	20	120
-	-	0.30	5.10	0.219	1.29	25	15	140
-	-	0.60	3.80	0.220	1.23	30	10	150
	$\bar{X}$		4.50	0.221	1.28	25	17	109
			Calcareous soil					
Conrol			4.10	0.180	1.20	15	10	70
0.15	-	-	4.60	0.191	1.25	20	10	110
0.30	-	-	4.50	0.205	1.30	25	15	120
0.60	-	-	4.20	0.215	1.20	30	20	130
-	0.15	-	4.30	0.215	1.22	30	20	100
-	0.30	-	4.40	0.220	1.25	30	25	105
-	0.60	-	4.16	0.230	1.30	20	25	100
-	-	0.15	4.10	0.220	1.30	20	20	130
-	-	0.30	4.36	0.200	1.36	25	15	145
-	-	0.60	4.02	0.180	1.32	30	10	160
	$\bar{X}$		4.27	0.206	1.27	25	17	118
			Alluvial soil					
Conrol			4.32	0.192	1.32	20	15	130
0.15	-	-	4.96	0.209	1.33	30	15	120
0.30	-	-	5.20	0.199	1.42	35	25	140
0.60	-	-	4.44	0.212	1.37	40	25	110
-	0.15	-	4.65	0.30	1.39	40	20	100
-	0.30	-	4.70	2.242	1.40	50	25	110
-	0.60	-	4.83	0.253	1.47	30	30	60
-	-	0.15	6.26	0.247	1.29	30	25	120
-	-	0.30	5.33	0.219	1.30	30	20	130
-	-	0.60	4.21	0.226	1.25	30	15	135
	$\bar{X}$		4.69	0.223	1.35	34	22	116

With regard to the effect of manurial treatments on the micronutrients concentrations in the falg leaf tissues for the different experiments , it could be noticed in Table 2 that application of the highest Mn rate increased Mn concentration, while Fe concentation slightly decreased and vice versa. In both treatments, higher concenttations of Zn were noticed. Watanable *et al.*, (1965) reported that function of iron in plants is affected by supply of Zn.

The effects of Zn, Mn and Fe treatments on the N, P and Kconcentrations in flag leaf samples taken at the booting stage are somewhat variable for sandy, calcareous and alluvial soils. Most data representing N, P and K - concentraions were found to be over the critical limit in most cases (Tyner 1974; Robinson 1969).

The results obtained clearly indicated that in order to ensure high production of wheat on the different soils, and full potential of wheat varieties as well as more efficient use of fertilizers having Zn , Mn and Fe, the coating method is considered important.

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تأثير إضافة الزنك والمنجنيز والحديد بطريقة التغليف على محصول القمح المنزرع بالأراضى المصرية

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أقيمت ثلاث تجارب حقلية على محصول القمح لدراسة تأثير عنصر الزنك والمنجنيز والحديد بطريقة تغليف التقاوى المنزرعة فى الأراضى الرملية والجيرية والطينية . استخدم ثلاثة تركيزات من كل عنصر هى : ١٥ر. ، ٣٠ر. ، ٦٠ر. جم / كيلو جرام تقاوى مع المقارنة.

وتتلخص النتائج المتحصل عليها بالنسبة لمكونات المحصول والتحليل لورقة العلم فيما يلى :

تأثر محصول القمح تأثراً ملحوظاً بإستخدام عنصر الزنك والمنجنيز والحديد بطريقة تغليف التقاوى حتى تركيز ٣ر . جم من كل عنصر ، وكانت نسبة الزيادة المئوية عند استخدام عنصر الزنك هى : ٧ر١٣ ٪ ، ٧ر١٤ ٪ ، ٦ر ١٥ ٪ فوق المقارنة بالأراضى الرملية والجيرية والطينية على الترتيب . وعلى نفس المنوال ، عند استخدام عنصر الحديد تحققت زيادة قدرها ٢ر١٥ ٪ ، ٢ر٢٢٪ ، ٨ر١١ ٪ فوق المقارنة ، اعطى المنجنيز بمعدل ١٥ر . نسبة زيادة قدرها .ر١٣ ٪ فوق المقارنة، لمختلف انواع الأراضى المستخدمة .

استجاب محصو ل القش بنفس اتجاهات محصول الحبوب تقريباً عند استخدام العناصر المغذية بمختلف الأراضى المستخدمة .

امكن الحصول على محصول بروتين ممتاز للحبوب بإستخدام عنصر المنجنيز يليه الحديد ثم الزنك .

تأثر كذلك تركيز عناصر الأزوت والفسفور والبوتاسيوم والزنك والمنجنيز والحديد لورقة العلم المأخوذة عند طور الحمل .