EVALUATION OF NUTRIENT USE EFFICIENCY (NUE) PARAMETERS FOR NITROGEN AND ZINC FERTILIZERS ON WHEAT PLANT IN ASSIUT GOVERNORATE, EGYPT.

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ABSTRACT

Field experiment was conducted to evaluate the use efficiency of nitrogen and zinc on growth and yield parameters of wheat plant. This work was carried out in clayey textured soil at Show village, Abnob district, Assiut Governorate, during the year, 2011-2012 season. A randomized complete block design experiment with three replicates was carried out using wheat (*Var.Sids* 8) as plant indicator. The experiment included 25 treatments i.e., five nitrogen application rates (0, 50, 75, 100 and 125 kg N fed^{-1}) as urea which was in two equal doses(after 25 and 40 days of sowing) at the time of irrigation. Also, five zinc application rates (0, 5, 10, 15 and 20 kg Zn fed^{-1}) as $ZnSO_4$ by broadcasting in powder form mixed with the soil at seedbed preparation.

Application of N at rates of 50, 75, 100 and 125 mg kg^{-1} resulted in percentage increases in yield of grains equivalent to 258, 223, 212 and 263 %, respectively as compared with the corresponding values of the control plants (0.0 level N). In case of straw, the corresponding increases were 227, 252, 250 and 199 %, respectively. The results show that application of Zn up to 10 mg kg^{-1} soil has a positive effect on grain yield of wheat. Addition of 5 and 10 mg Zn kg^{-1} soil caused significant (0.05) increases in yield; the increases were 51 and 26 %, respectively over the control treatments.

Concerning the interaction between nitrogen and zinc application, data showed that the 1000 grain weight values increased by using different levels of N and Zn compared with the control, where the 50 kg N fed^{-1} with 10 kg Zn fed^{-1} caused significant increases in the yield and the best treatment of the 1000 grain weight grams. On the other side, increasing Zn application over 10 kg fed^{-1} caused pronounced and significant decreases in weight yield. The interaction effect of N and Zn treatment on grains and straw attained its highest values conceded, with of 125 kg N and 5 kg Zn fed^{-1} and 75 kg N fed^{-1} + 5 kg Zn fed^{-1}, respectively. The results showed that the rate of 50 kg N/fed, gave the best Physiological efficiency (PE) compared with other treatments (i.e., 75, 100 and 125 kg N/fed). While, the values were increased as the application rates of Zn increased (i.e. 5 and 10 kg zinc/fed), and then decreased with increasing Zn application (i.e. 15 and 20 kg Zn /fed). The best physiological efficiency (PE) accompanied with the rate of 10 kg zinc/fed.

Key words: Nutrien, Zinc, Wheat plant**.**

INTRODUCTION

Wheat is the most important cereal crop in Egypt and the world. Different nutrition elements are required in order to grow wheat sufficiently such as nitrogen, phosphorous, potassium, calcium and magnesium, but in different quantities **(Lucas 1996).** Nitrogen is a macro element that has an important role within molecules, enzymes, co-enzymes, nucleic acid and cytochromes **(Uhart and Andrade 1995). Verma and Bhagat (1990)** reported that a decrease of grains yield can be attributed to a lack of nitrogen.

Continuous use of high doses of nitrogenous fertilizers to meet the intensive cultivation of high yielding crop varieties during the last few decades have resulted in widespread Zn deficiency in almost all soil types (**Verma and Bhagat, 1990).** Egypt is a wheat-growing nation and wheat is the main staple food and major cereal crop in Egypt. So, application of micronutrients i.e., Zn is an option for increasing yield. It is evident that for obtaining increased yield of wheat, Zn status of the soils should be improved using Zn fertilizers **(Shaheen *et al*., 2007).**

Baligar *et al* (2001) reported that many agricultural soils of the world are deficient in one or more of the essential nutrients needed to support healthy plants. Additions of fertilizers and/or amendments are essential for a proper nutrient supply and maximum yields. Estimates of overall efficiency of applied fertilizer have been reported to be about or lower than 50% for N, less than 10% for P, and about 40% for K. Plants that are efficient in absorption and utilization of nutrients greatly enhance the efficiency of applied fertilizers, reducing cost of inputs, and preventing losses of nutrients to ecosystems. Inter- and intra-specific variation for plant growth and mineral nutrient use efficiency (NUE) are known to be under genetic and physiological control and are modified by plant interactions with environmental variables. There is need for breeding programs to focus on developing cultivars with high NUE. Identification of traits such as nutrient absorption, transport, utilization, and mobilization in plant cultivars should greatly enhance fertilizer use efficiency. The development of new cultivars with higher NUE, coupled with best management practices (BMPs) will contribute to sustainable agricultural systems that protect and promote soil, water and air quality.

Nutrient efficiency as the ability of genotype/cultivar to acquire nutrients from growth medium and/or to incorporate or utilize them in the production of shoot and root biomass or utilizable plant material (seed, grain, fruits, forage). Higher Nutrient Use Efficiency (NUE) by plants could reduce fertilizer input costs, decrease the rate of nutrient losses, and enhance crop yields. Genetic and physiological components of plants have profound effects on their abilities to absorb and utilize nutrients under various environmental and ecological conditions. Genetic, morphological, and physiological plant traits and their interactions with external factors such as soil moisture and temperature, light, best management practices, soil biological, and fertilizer materials need to be more thoroughly evaluated to improve the NUE in plants **(Blair 1993).**

The evaluation of NUE is useful to differentiate plant species, genotype and cultivars for their ability to absorb and utilize nutrients for maximum yields. The NUE is based on (a) uptake efficiency (acquire from soil, influx rate into roots, influx kinetics, radial transport in roots are based on root parameters per weight or length and uptake is also related to the amounts of the particular nutrient applied or present in soil), (b) incorporation efficiency (transports to shoot and leaves are based on shoot parameters) and (c) utilization efficiency (based on remobilization, whole plant i.e. root and shoot parameters), **Gerloff and Gablemen (1983); and Baligar and Fageria (1997).**

The present investigation was undertaken to study the evaluation of Nutrient Use Efficiency (NUE) of nitrogen and zinc fertilizers on growth and yield parameters of wheat crop in Assiut Governorate, Egypt.

MATERIALS AND METHODS

Field experiment was conducted to evaluate the effect of nitrogen and zinc fertilizers on growth and yield parameters, of wheat crop.

This work was carried out at Show village, Abnob District, Assiut Governorate, Egypt which lies between 30°45$^-$ to 31°24$^-$, North and 70°44$^-$ to 71°50$^-$, East, during, 2011-2012 season. The experimental soil was a Typic Torrifluvent, fine loamy, mixed, hyperthermic. Soil texture was clay having the following characteristics: sand 9.12 %, silt 12.56 %, clay 78.32 %, pH 7.1, Organic matter 2.13 %, $CaCO_3$ 1.7%, EC 2.05 dSm^{-1}, available N 17.5 mg kg^{-1}, AB-DTPA extractable Zn 0.23 mg kg^{-1}.

The experiment layout was a randomized complete block design with three replicates using wheat plants (*Var. Sids* 8) as plant indicator. It included 25 treatments i.e., five nitrogen application rates (0, 50, 75, 100 and 125 kg N/Fadden) as urea which was applied in two equal doses after 25 and 40 days of sowing at the time of irrigation and five zinc application rates (0, 5, 10, 15 and 20 kg/Fadden) as $ZnSO_4$ by broadcasting in powder form mixed with soil at the time of seedbed preparation. The experiment included 75 plots of (3.0*3.0 m^2) with between plots and total area of about 675 m.^{2} A drill hand machine on 26 Nov 2011 was used for sowing. The recommended doses of P and K were used at 100 kg P_2O_5 and 60 kg K_2O fed^{-1} in all treatments.

The crop was harvested at maturity (7 May 2012), grains and straw yields were determined. The samples of grains and straw were rinsed with tap water, then with distilled water and finally were kept at 70°C for 48 h. The dried and ground plant materials (0.5 g) were digested with sulphuric acid and hydrogen peroxide according to **Wolf (1982)**. Nitrogen was determined using macro Kjeldhal method described by **Klute (1986)** and Zn was determined with atomic absorption spectrophotometer ("GBC", 932 AA), **Jackson (1976).**

Soil physical and chemical properties were conducted according to **Kulte (1986) and Page *et al*. (1982).** Zinc was extracted by AB-DTPA (*1* N NH_4HCO_3 + *0.005* M diethylenetriaminepenta acetic acid) according to **(Soltanpour, 1985)** and was determined by the atomic absorption spectrophotometer, "GBC", 932 AA, **Jackson (1976).**

Statistical differences were determined by analysis of variance (ANOVA) followed by the least significant difference (LSD) test for multiple comparisons among groups using MSTAT-C software **(Scott, 1999)**. Differences were considered statistically significant at (0.05).

Nutrient Use Efficiency (NUE): According to **Fageria, *et al*, 1996)**

1- **Agronomic efficiency (AE):** is defined as the economic production obtained per unit of nutrient applied. It can be calculated by:

$$AE\ (kg\ kg^{-1}) = \frac{(Yield\ F, kg - Yield\ C, kg)}{Quantity\ of\ nutrient\ applied, kg}$$

Where **F** is plants receiving fertilizer and **C** is plants receiving no fertilizer.

2- **Physiological efficiency (PE)** is defined as the biological production obtained per unit of nutrient absorbed. It can be calculated by:

$$PE\ (kg\ kg^{-1}) = \frac{yf - yu}{(Nutrient\ uptake\ F,\ kg - Nutrient\ uptake\ C,\ kg)}$$

Where **yf** is the total dry matter yield of the fertilized crop (kg), yu is the total dry matter yield of the unfertilized crop (kg).

3- **Apparent nutrient recovery efficiency (ANR)** has been used to reflect plant ability to acquire applied nutrient from soil. It can be calculated by:

$$\textbf{ANR}=\frac{(Nutrient\ uptake\ F,kg - Nutrient\ uptake\ C,kg)\times 100}{Quantity of nutrient applied,kg} = \%$$

RESULTS AND DISCUSSION

Yield of wheat plants:

Results presented in Table (1) show that the grains and straw weight yields of wheat were significantly (0.05) increased progressively with application of N. The ascending application rates of N (50, 75, 100 and 125 mg kg^{-1}) were coupled with increases in yield of grains equivalent to 258, 223, 212 and 263 % respectively as compared with the control (0.0 kg N/ fed). In case of straw, the corresponding increases for the aforementioned rates were 227, 252, 250 and 199 %, respectively. The highest increase in straw of wheat were associated with treatment receiving 100 mg kg^{-1} N. These results are agreement with those obtained by **Verma and Bhagat, 1990.**

Table (1). Effect of applied zinc and nitrogen rates on dry matter yield and 1000 grains of wheat plant**.**

Applied N (kg/fed)	Applied Zn (kg/fed)					
	Grain yield (ton\ fed)					
	0.0	5.0	10.0	15.0	20.0	Mean
0.0	0.58	0.86	0.24	0.34	0.21	0.48
50	1.26	2.36	1.82	1.8	1.39	1.73
75	1.38	1.66	2.02	1.37	1.3	1.56
100	1.73	1.86	2.09	0.96	0.89	1.51
125	1.85	2.91	1.65	1.71	1.03	1.83
Mean	1.36	1.93	1.61	1.24	0.96	
LSD. 0.05	Zn = 0.0013		Zn* N_2 = 0.0926		N_2 = 0.0013	
	Straw yield (ton\ fed)					
0.0	1.61	1.51	1.14	0.80	0.46	1.10
50	3.25	3.86	4.41	2.67	2.88	3.41
75	3.31	4.71	4.14	3.17	3.00	3.66
100	3.61	4.25	4.15	3.60	2.61	3.64
125	3.39	3.43	3.25	3.24	2.75	3.01
Mean	3.034	3.55	3.41	2.69	2.34	
LSD. 0.05	Zn = 0.066		Zn* N_2 = 0.148		N_2 = 0.066	
	1000 grains weight (grams)					
0.0	36.46	25.07	32.73	22.86	26.62	26.75
50	46.45	48.56	50.89	49.17	43.31	47.68
75	49.22	49.49	50.65	49.05	49.12	49.51
100	46.15	49.76	50.13	50.26	49.46	49.15
125	49.31	50.22	50.25	50.58	49.93	50.058
Mean	45.52	44.63	46.93	44.38	43.69	
LSD. 0.05	Zn = 1.08		Zn* N_2 = 2.418		N_2 = 1.08	

The addition of 5 and 10 mg Zn kg^{-1} soil caused positive and significant (0.05) increases in yield; (51 and 26 % of control treatment, as mean, respectively). On the other side, increasing Zn application over 10 mg kg^{-1} caused pronounced and significant decreases in the yields. The magnitudes of decrease at 15 and 20 mg

kg^{-1} applications in grains were 3.5 and 25 % of control treatment, as mean, respectively. Application of Zn at rates of 5, 10, 15 and 20 mg kg^{-1} caused increases in yield of straw equivalent to 68, 62, 25 and 11 % respectively as compared with the corresponding values of zero application treatment (as mean).

Comparisons of means for effects of interactions between nitrogen and zinc on weights of either grains or straw of wheat showed significant effects. The highest effect of the interaction for grains was associated with treatment of (125 mg N kg^{-1} + 5 mg Zn kg^{-1}), while the corresponding treatment for straw was (75 mg N kg^{-1} + 5 mg Zn kg^{-1}).

Data in Table 1 indicate that the 1000 grain weight had significantly (0.05) affected by different application levels in the tested soil. The results reveal that the 1000 grain weight values are significantly (0.05) increased by increasing nitrogen addition rates, where the 125 kg nitrogen fertilizer application soil gave the highest values. In case of zinc rates, 1000 grain weight significant vales are (0.05) increased by increasing zinc addition rates, where the rate of 10 kg Zn fed^{-1} in the tested soil gave the highest values. Concerning the interaction between nitrogen and zinc application, data show that the 1000 grain weight values increased by using different levels of N and Zn compared with the control, where the rate of (50 kg N/fed, and 10 kg Zn fed^{-1}) caused significant and the best treatment. These results are in agreement with **Khan, *et al.*, (2008)**

Nitrogen uptake (kg fed^{-1}) by wheat plants:

Data presented in Table (2) indict that application of nitrogen fertilizers resulted in significant progressive increases in the uptake of N in both grains and straw of wheat. Application of N at rates of 50, 75, 100 and 125 mg kg^{-1} resulted in percentage increases in N uptake in grains equivalent to 270, 256, 281 and 296 % of control treatment, respectively. In case of straw, the

Table (2): Nitrogen uptake (kg. fed^{-1}) by wheat plant on the studied soil.

Applied N(kg/fed)	Applied Zn (kg/fed)					
	0	5	10	15	20	Main
	kg N. fed^{-1} (Grains)					
0.0	0.66	4.27	2.47	1.56	1.14	2.02
50	5.17	12.0	6.79	8.11	5.37	7.488
75	5.18	11.6	8.52	5.98	4.74	7.204
100	9.17	9.45	9.58	6.45	3.87	7.722
125	6.1	9.77	8.14	8.41	2.70	8.024
Main	5.26	9.41	7.10	6.10	3.56	
LSD. 0.05	Zn = 0.373		Zn* N_2 = 0.844		N_2 =0.373	
	kg N. fed^{-1} (Straw)					
0.0	0.43	2.71	2.32	1.35	1.21	1.60
50	4.23	5.15	5.73	3.88	4.42	4.682
75	5.18	5.7	6.62	4.76	4.29	5.310
100	6.13	5.19	6.78	4.79	4.24	5.426
125	5.62	7.35	4.46	3.71	2.39	4.704
Main	4.32	5.22	5.18	3.70	3.31	
LSD. 0.05	Zn = 0.302		Zn* N_2 = 0.898		N_2 = 0.302	

corresponding increases were 221, 264, 272 and 222 %, respectively, compared with the control plants (0.0 level of N). The highest increases in the N uptake in grains and straw of wheat were associated with treatments received 125 and 100 mg N kg fed^{-1}, respectively.

However, the results show that application of Zn up to 5 mg kg^{-1} soil had a positive effect on the uptake of N. Addition of 5 or 10 mg Zn kg^{-1} soil caused significant (0.05) increases in the yield; (i.e. 49.2 and 12.7 % over the control treatments).

On the other side, increasing Zn application over 10 mg kg^{-1} resulted in pronounced and significant decreases in the yields. The magnitude of N decrease in grain yield at application rates of 15 and 20 kg Zn fed^{-1}, were -3.1 and -5.8 % of control treatment, respectively. Application of Zn at rates of 5, 10, 15 and 20 mg kg^{-1} resulted in percentage increase in the yield of straw equivalent to 20.8, 19.9, -14.3 and -26.62 % of control treatment, respectively. These results are in agreement with these obtained by **Khan *et al* (2008),** who found that all applications of zinc sulphate gave economic increases in margins over costs but the application of 5 kg ha^{-1} gave the highest marginal rate of return.

Data show that the uptake of N in both grains and straw of wheat increased significantly compared with the control due to the interaction effects between zinc and nitrogen fertilizers. The highest effect of interaction was associated with treatment of 50 kg N fed^{-1} + 5 kg Zn fed^{-1} for grains, while for straw, the corresponding treatment was 125 kg N fed^{-1} + 5 kg Zn fed^{-1} soil.

Zinc uptake (g.fed^{-1}) by wheat plants:

Data presented in Table (3) reveal that application of zinc fertilizer resulted in significant increases in the uptake of zinc by both grains and straw of wheat. The increases were progressive coincide with increasing the rate of added

Table (3): Zinc Uptake (gm. Fed^{-1}) by wheat plants in the studied soil.

Applied N (kg/fed)	Applied Zn (kg/fed)					
	0.0	5.0	10.0	15.0	20.0	Main
	gm. Fed^{-1} (Grains)					
0.0	15.4	165	94.1	90.6	57.98	84.6
50	65.5	564	455	488	383.4	447.0
75	109	372	528	472	381.4	416.8
100	233	430	519	296	332.1	353.0
125	325	718	450	510	252	451.0
Main	150	450	409.2	371.3	372	
LSD. 0.05	Zn = 19.8		Zn* N_2 = 44.28		N_2 = 19.8	
	gm. Fed^{-1} (Straw)					
0.0	7.58	12.9	14.5	13.7	4.18	10.6
50	19.5	69.4	162	66	36.5	70.7
75	28	59.5	124	110	72.1	78.7
100	45.7	53.8	124	146	101	94.1
125	57.4	23.9	79.4	84.2	87.9	66.6
Main	31.6	43.9	100.78	83.98	60.3	
LSD. 0.05	Zn = 1.035		Zn* N_2 = 5.475		N_2 = 1.035	

nitrogen. Application of N at rates of 50, 75, 100 and 125 kg N fed^{1} soil resulted in increases in zinc uptake by grains equivalent to 428, 463, 317 and 388 % of control treatment, respectively. In case of straw, the corresponding increases were 567, 642, 788 and 478 %, respectively. The highest zinc up tike values in grains and straw were associated with treatment receiving 75 and 100 kg N fed^{-1}, respectively.

While, increasing Zn application rates, resulted in significant progressive increases in the uptake of zinc by both grains and straw of wheat. As application of Zn at rates of 5, 10, 15 and 20 kg fed^{-1} resulted in percentage increases in zinc uptake in grains equivalent to 302, 265, 232 and 286 % of control treatment, respectively. In case of straw, the corresponding increases were 66, 282, 218 and 128%, respectively. The highest increase in grains and straw of wheat were associated with treatments receiving 5 and 10 kg fed^{-1}, respectively.

Comparisons of means for effects of interactions between zinc and nitrogen on weights of grains and straw of wheat in Table 3 showed that the effects were significant. The highest effect of interaction for grain was associated with treatment of 125 kg N fed^{-1} + 5 kg Zn fed^{-1}. For straw, the corresponding treatment was with 75 kg N fed^{-1} + 10 kg Zn fed.$^{-1}$

Available values of zinc and nitrogen in the studied soil.

Data in Table 4 indicate that available values of nitrogen and zinc were affected by different application levels of N and Zn fertilizers in the tested soil. With respect to available nitrogen, the results show that nitrogen increased significantly (0.05) by using higher application rates of nitrogen fertilizer, where the rate of 100 kg N/fed, level was significantly (0.05) the best compared with the other treatments. The soil that available nitrogen values after harvest increased through the different interaction application rates of each N and Zn, where the treatment of 100 kg N/fed at 20 kg zinc/fed was better than the other treatments. These results are in agreement with those obtained by Mahmoud et al. (1993) who found that the clay soil of Bahteem farm contained 50 mg kg^{-1} of available N.

Table (4): Soil available nitrogen and zinc after harvest.

Applied N (kg/fed)	Applied Zn (kg/fed)					
	0.0	5.0	10.0	15.0	20.0	Main
Available N_2 (mg. kg^{-1})						
0.0	3.67	4.53	3.02	3.57	5.57	4.07
50	30.6	46.4	43.1	52.5	43.5	43.22
75	43.0	50.3	47.2	37.4	53.1	46.20
100	42.8	53.6	51.4	48.4	61.5	51.54
125	38.8	53.0	52.3	54.4	53.0	50.30
Main	31.8	41.6	39.40	39.25	43.33	
LSD. 0.05	Zn = *0.949*		*Zn* N_2 = 2.124*		*N_2 = 0.949*	
Available Zn (mg. kg^{-1})						
0.0	0.15	0.27	0.50	0.32	0.85	0.42
50	0.17	0.86	0.46	0.35	1.11	0.60
75	0.16	0.65	0.66	0.43	0.76	0.53
100	0.15	0.37	0.79	0.36	0.79	0.50
125	0.24	0.40	0.41	0.26	0.85	0.432
Main	0.17	0.51	0.56	0.34	0.87	0.49
LSD. 0.05	Zn = 0.008		Zn* N_2 = 0.1975		N_2 = 0. 008	

The results reveal that available values of zinc in the soil after harvest were increased or decreased due to zinc addition rates. DTPA-extractable zinc ranged widely from 0.15 to 1.11mg kg^{-1} in the studied soil. According to Lindsey and Norvell (1978), soils under consideration showed inadequate level (> 1.0 mg. Kg^{-1}) of available zinc, except soil treatment of 50 kg N + 20 kg Zn / fed.

Nutrient Use Efficiency parameters (NUE) for N fertilizer:

Data in Table 5 indicate that the Physiological efficiency (PE) kg. kg^{1}, Agronomic efficiency (AE) kg kg^{-1}, and Apparent recovery efficiency (ARE) % values were affected by different application rates of N and Zn in the tested soil.

The results show that the rate of 50 kg N/fed soil, gave the best Physiological efficiency (PE) values compared with the other treatments as mean values. While, increasing the rates of nitrogen application (i.e. 75, 100 and 125 kg N/fed) decreased their values. Increasing the application rates of Zn to 5 and 10 kg zinc /fed soil increased the Physiological efficiency, then decreased with increasing Zn application to 15 and 20 kg Zn /fed as mean values. While the best Physiological efficiency (PE) was found at the rate of 10 kg zinc /fed soil.

Table (5): Nutrient Use Efficiency (NUE) for N fertilizer.

Applied N (kg/fed)	Applied Zn (kg/fed)					
	0	5	10	15	20	Mean
	Physiological Efficiency (PE) kg. kg^{-1}					
50	231.04	378.56	627.42	366.74	442.26	409.02
75	226.53	387.59	466.66	434.22	491.86	401.37
100	193.52	482.58	420.05	410.56	438.08	388.96
125	144.59	391.51	450.70	376.76	292.01	331.12
Mean	198.92	410.06	491.21	397.07	416.06	
Agronomic Efficiency (AE) Kg. Kg^{-1}						
50	13.6	30.00	31.60	29.20	23.60	25.60
75	6.93	18.93	23.06	15.46	17.33	16.34
100	11.5	10.00	18.50	6.20	6.80	10.60
125	7.04	16.40	11.28	10.96	6.56	10.44
Mean	9.76	18.83	21.11	15.45	13.57	
Apparent nutrient recovery efficiency (NRE)						
50	13.62	20.34	15.46	18.16	16.28	17.37
75	11.36	13.76	13.80	10.44	9.84	12.04
100	12.21	7.75	11.57	8.33	6.46	9.66
125	11.50	8.11	6.24	7.36	8.52	8.55
Mean	12.07	12.49	11.77	11.07	10.27	

Nutrient Use Efficiency parameters (NUE) for Zn fertilizer.

Data in Table (6) show that the rate of 75 kg N + 5 kg Zn/fed, gave the best Physiological efficiency (PE) compared with the other treatments. Increasing the application rates of Zn to 5 and 10 kg zinc /fed increased the Physiological efficiency, then decreased with increasing Zn application to 15 and 20 kg Zn /fed soil. If trace elements present at excess levels pose phyto-toxicity and can reduce plant growth and nutrient uptake and eventually reduce NUE **(Baligar and Ahlrichs., 1998; and Marschner, 1995).** Data in Table 6 show that Agronomic efficiency (AE) kg kg^{-1} value was affected by different application rate of Zn. As the application rate of 5 kg zinc fed^{-1} was the best treatments. Concerning the interaction between N and Zn, data showed that the 50 kg N at 5 kg Zn fed^{-1} was the best treatment. Also the results in Table (6) show that Zn Apparent nutrient recovery efficiency (NRE) % values were affected by the different application rates of nitrogen and zinc fertilizers, as the 50 kg N fed^{-1} was the best treatment. While in case of zinc addition rates, NRE increased as result of addition 5 kg zinc fed^{-1}. As for the interaction, NRE was 50 kg N with 5 kg Zn fed^{-1} was the best treatment s. These results are in as agreement with those obtained by **Khan *et al* (2008).**

Table (6): Nutrient Use Efficiency (NUE) for Zn fertilizer.

Applied N (kg/fed)	Applied Zn (kg/fed)				
	5	10	15	20	Mean
	Physiological Efficiency (PE) kg. kg^{-1}				
0.0	1162	-9460	-16	-18	-2083
50	3394	3052	36	27	1627.25
75	5335	4667	-10	-4.0	2497
100	3754	4388	-51	-42	2012.25
125	3060	3060	-9.0	-41	1517.5
Mean	2729	529.4	-10.25	-9.25	
	Agronomic Efficiency (AE) Kg. Kg^{-1}				
0.0	56	-34	-16	-18.6	-3.0
50	220	56	36	27	85
75	56	64	-10	-4.0	26
100	26	36	-51	-42	-8.0
125	212	-20	-9.3	-41	36
Mean	114	20	-8.2	-7.4	
	Apparent nutrient recovery efficiency (NRE)				
0.0	3.098	0.856	0.542	0.196	1.173
50	10.076	5.603	3.206	2.905	5.447
75	6.298	3.149	3.103	4.293	4.211
100	4.102	2.051	1.089	0.542	1.946
125	9.190	4.60	2.080	0.290	4.040
Mean	6.55	3.25	1.870	1.640	

REFERENCES

Baligar, V. C. and J. Ahlrichs. 1998. Nature and distribution of acid soils in the world. Pp. 1–11. In: R.E. Schaffert. Proc. of workshop: Develop an Strategy for Collaborative Research and Dissemination of Technology. Purdue University,W. Lafayette, IN.

Baligar, V.C. and Fageria, N.K. 1997. Nutrient use efficiency in acid soils: Nutrient Management and Plant use Efficiency, (ed.) pp. 75–93.Brazili-an Soil Science Society Compinas, Brazil.

Baligar, V.C.; Fageria, N.K. and He, Z.L. 2001. Nutrient use efficiency in plants. Commun. Soil Sci. Plant Anal., 32(7 & 8), 921–950.

Blair, G. 1993. Nutrient efficiency-what do we really mean. Genetic Aspects of Plant Mineral Nutrition. pp. 205–213. In: P. J. Randall, E. Delhaize, R. A. Richards, and R. Munns. (eds.), Kluwer Academic Publishers, Dordrecht, the Netherlands.

Craswell, E.T., and P.L.G. Velk. 1979. Fate of fertilizer nitrogen applied to Wetland rice. pp. 175–192. In: IRRI (ed.), Nitrogen and Rice IRRI, Los Banos, Philippines.

Fageria, N.K.; Baligar, V.C. and Jonses, C.A. 1996. Growth and mineral Nutrition of Field Crops. (ed.), Printed Marcel Dekker, Inc. U.S.A. chapter 9, pp. 324- 325.

Gerloff, G.C. and Gabelman, W.H. 1983. Genetic basis of inorganic plant nutrition.pp 453– 480. In: A Lauchli and R L Bieleski. (eds.), Inorganic Plant Nutrition. Encyclopedia and Plant Physiology New Series, Volume 15B. Springer Verlag, New York.

Jackson, M.L. (1967). Soil Chemical Analysis. Prentice Hall of India Ltd; New Delhi.

Khan, M.A.; Fuller, M.P. and Baloch, F.S. 2008. Effect of Soil Applied Zinc Sulphate on Wheat (*Triticumaestivum* L.) Grown on a Calcareous Soil in Pakistan *Cereal Research Communications* 36(4), pp. 571–582

Klute, A.; 1986. Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods (Sssa Book Series No 5)

Habtegebrial, K., Sing, B.R., and Haile, M. 2007. Impact of tillage and nitrogen fertilization on yield, nitrogen use efficiency of tef [Eragrostis tef (Zucc.) Trotter] and soil properties. Soil Till. Res. 94:55–63.

Lindsay, W.L. and Norvell, W.A. 1978. Development of DTPA test for Zinc, Iron, manganese and copper. Soil Sci., Soc. Amer. Proc., 421 -216.

Lucas, E.O. 1996. Effect of density and nitrogen fertilizer on the growth and yield of maize (*Zea mays* L.) in Nigeria. Journal of Agricultural Science 107: 573-578.

Mahmoud, M.H.; Kadry, W.; El-Mallah, M.L. and Mahdy, M.A. 1993. Effect of residual N in soil on flax and corn successively after sunflower. Egypt. J. Soil Appl. Sci, 8 (7): 111 - 122

Marschner, H. 1995. Mineral Nutrition of Higher Plants. Academic Press, San Diego, CA.

Page, A.L., M.H. Miller and D.R. Keeny 1982**.** Methods of Soil Analysis, Part II, 2nd edition, American Society of Agronomy Madison.

Scott, P.E. 1999. MSTAT-C software. Crop and Soil Sciences Dept., Michigan State University.

Shaheen, R., Samim, M.K. and Mahmud, R. 2007. Effect of zinc on yield and zinc uptake by wheat on some soils of Bangladesh. *J. Soil Nat.,* 1: 7–14.

Soltanpour, P.N. 1985. Use of AB-DTPA soil test to evaluate elemental availability and toxicity. *Comm. Soil Sci. Plant Anal.,* 16: 323–338.

Uhart, S.A. and Andrade, F.H. 1995. Nitrogen deficiency in maize: carbon-nitrogen interaction effects on kernel number and grain yield. Crop Sci., 35:1384-1389.

Verma, T.S. and Bhagat, R.M. 1990. Zinc and nitrogen interaction in wheat grown in limed and unlimed acid alfisol. Fertilizer Research 22:29-35.

Wolf, B. (1982). The comprehensive system of leaf analysis and its use for diagnosing crop nutrient status. *Comm. Soil Sci. Plant Anal.,* 13: 1035–1059.

تقييم معاملات كفاءة أستعمال المغذيات لسمادي النتروجين والزنك
علي نبات القمح في محافظة أسيوط مصر

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أجريت تجربة حقلية لتقييم كفاءة استخدام المغذيات Nutrient Use Efficiency (NUE) لأسمدة عنصري النيتروجين والزنك على نباتات القمح في محافظة أسيوط، مصر. تمت هذه الدراسة علي تربة طينية في قرية شواي مركز أبنود محافظة أسيوط خلال موسم ٢٠١٢/٢٠١١. وكان لتصميم تجربة القطاعات العشوائية الكاملة بثلاث مكررات باستخدام القمح صنف سدس ٨. وشملت هذه التجربة ٢٥ معاملة واستخدمت خمسة مستويات من الزنك (صفر، ٥، ١٠، ١٥، ٢٠ كجم زنك/ فدان) وكان المستخدم في صورة مسحوق كبريتات الزنك يخلط مع التربة في وقت تحضير البذور وخمس مستويات للنيتروجين (صفر، ٥٠، ٧٥، ١٠٠، ١٢٥ كجم نيتروجين/ فدان) والسماد المستخدم اليوريا والتي تم إضافتها على جرعتين متساويتين بعد ٢٥ ، ٤٠ يوما من الزراعة في وقت الري.

وقد بينت النتائج أن استعمال ١٠ كجم زنك للفدان كان له تأثير موجب علي إنتاجية الحبوب. وأن إضافة ٥، ١٠ كجم زنك للفدان أدي إلي زيادة المحصول بنسبة أعلي من معاملة المقارنة بـ ١٥، ٢٠ % علي الترتيب. بينما إضافة النتروجين بمعدلات ٥٠، ٧٥، ١٠٠، ١٢٥ كجم للفدان أدي إلي زيادة الحبوب بنسبة ٢٥٨، ٢٢٣، ٢١٢، ٢٦٣% وزيادة القش بنسبة ١٩٩، ٢٥٠، ٢٥٢، ٢٢٧ % علي الترتيب. التداخل بين الزنك والنتروجين كان أعلي زيادة لوزن ١٠٠٠ حبة مع ٥٠ كجم نتروجين + ١٠ كجم زنك للفدان. والكفاءة الفسيولوجية والكفاءة المحصولية وارتبطت أعلي القيم لهذه القياسات بالمعاملة (٥٠ كجم نتروجين + ٥ كجم زنك لكل فدان).