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Study of Wheat Response to Nitrogen Fertilization, Micronutrients and their Effects on Some Soil Available Macronutrients

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THE PRESENT investigation was carried out in the Experimental Farm of Faculty of Agriculture, Kafr El-Sheikh University during the two successive winter growing seasons of 20122013/ and 20132014/ in the same location to study the long term effect using one variety of wheat (*Triticum aestivum* L.), cv. Masr 1. The experiment was conducted in split-split plot design, with four replicates. The main plots were randomly assigned to nitrogen levels (0, 40 and 80 kg N/fed), the sub plots were represented by the two chelated forms of humic and EDTA as foliar application and the sub-sub plots were represented by four micronutrients spraying of Fe, Cu, Mn and Zn, each one in two concentrations. The objectives of the present study were to investigate the effect of different levels of N and foliar application of some chelated micronutrients on: (1) grain yield and yield component of wheat plant (2) uptake of N, P and K by wheat under different treatment of N rates and micronutrients and (3) some soil available macronutrients. The results showed that, the best treatments were N_{80}, Zn_2 and Mn_2 which gave the highest production for wheat grain and straw yield which indicate the importance of balance fertilization for wheat crop. These results also indicated that, improving soil fertility and replenishment nutrients depletion under the conditions of the present study could be achieved using previous treatments.

Keywords: Wheat, Nitrogen, Zinc, Copper, Manganese, Iron

Introduction

Wheat (*Triticum aestivum* L.) is considered the major cereal crop in the world in respect of the cultivated area and total production. It provides an almost 20% of food energy for people in Egypt. Increasing wheat production is the ultimate goal to reduce the wide gap between production and consumption which amount to 40% of production. Nitrogen plays a key role in this plant nutrition. Nitrogen required in the greatest quantity by cereal crops. As a result of its critical role and low supply the management of N resources is an extremely important aspect of crop production (Sebastiano *et al.*, 2005). Foliar fertilization of urea and potassium cause a significant stimulatory effect on growth parameters using foliar feeding at 65, 90 and 115 days after sowing (Mahmed *et al*., 2010). Nitrogen is applied in order to increase yield and improve crop quality. Nitrogen fertilization contributes significantly to protein content (Ames et al., 2003).

Labuschagne et al. (2006) concluded that N fertilizer rate and the time of application affects the fractional composition of proteins. Increasing fertilizer level up to 90 kg N /fed significantly increased yield and yield components compared with lower fertilizer levels and the control .Also, foliar application with mixture of micronutrients in addition to fertilizing with 90 kg N fed^{-1} can maximize wheat grain and straw yields and gave the best quality parameter of grains (Seadh et al., 2009). On the other hand, increasing nitrogen fertilizer rates (75, 100, 125 kg N/feddan) resulted in significant increase in grain yield, straw yield and biological yield (Ibrahim et al., 2014).

Micronutrients play key roles in the release of carbon dioxide, and in optimizing the function of vitamin A and the immune system, as stated by Marschner (1995). Zinc (Zn) is known to have an important role either as a metal component of enzymes or as a functional, structural or regulatory cofactor of a large number of enzymes (Grotz & Guerinot 2006 and Cakmak, 2008). Grain yield, straw yield, 1000-grain weight and number of grains/spike, Fe, Mn and Zn concentration in flag leaves and grains as well as protein content in grain

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were significantly increased by application of these elements (Zeidan *et al*., 2010). Zinc is an essential micronutrient, which its deficiency is common in wheat growing areas of the world particularly in alkaline soils. In alkaline soils, Zn is fixed or precipitated in unavailable forms. Specially in wheat, improvement yield and yield components were affected by foliar application of zinc, boron and copper (Daneshbakhsh *et al*., 2013). Also the foliar application with the combination of micronutrients (Cu + Fe + Mn + Zn) produce the highest values of plant height, tillers number, spikes number, spike length, number of spikelets spike^{-1}, number of grains spike^{-1}, 1000-grain weight, grain yield, straw yield, biological yield and harvest index (Mekkei and El-Haggan, 2014). The micronutrients content in wheat grains and straw positively correlated with silt, clay, organic carbon and CEC and negatively correlated with sand, $CaCO_3$ and pH of soils (Kumar, 2011). Humic acid might benefit plant growth by chelating unavailable nutrients and buffering pH (Julie & Bugbee 2006 and Zancani *et al*., 2009). The functional groupings of the humic substances act as acids or bases, as anion and cation changers and specific absorbent for the nutritive and harmful substances. Also increasing humic acid at rate 4 kg/fed with Zn and Mn mixture produced the highest mean values of growth (Radwan *et al*., 2015). The aim of this work was to study the effect of three nitrogen fertilizer levels soil application and some micronutrients (Fe, Cu, Mn and Zn) adding in two chelated forms of humic and EDTA as foliar application on soil properties, wheat yield and its components.

Materials and Methods

Two field experiments were carried out at the Experimental Farm of Faculty of Agriculture, Kafr El-Sheikh University, Kafr El-Sheikh Governorate, during the two successive winter growing seasons of 20122013/ and 20132014/ at the same location to study the long term effect using one variety of wheat (*Triticum aestivum* L.), cv. Misr 1. The wheat seeds were obtained kindly from the Agricultural Research Station, Sakha, Kafr El-Sheikh, Egypt to study the effect of three nitrogen fertilizer levels soil application and some micronutrients (Fe, Cu, Mn and Zn) adding in two chelated forms of humic and EDTA as foliar application on soil properties, wheat growth, yield and its components. Split-split plot design, with four replicates was the experimental design. The main plots were randomly assigned to three nitrogen levels (0, 40, and 80 kg N/fed), the sub plots were subjected to two forms of chelates for the micronutrients added as foliar application *i.e.*, EDTA and humic.

The sub-sub plots were represented by two concentration of four micronutrients spraying solution of Fe, Cu, Mn and Zn as a sulphate form (200 and 300 mg L^{-1} for Fe, 70 and 100 mg L^{-1} for Mn, 30 and 50 mg L^{-1} for Zn, 30, 50 mg L^{-1} for Cu) in addition to control without spraying. Micronutrients were sprayed twice, the first at the tillering stage (35 days from sowing) and the second one at the booting stage (70 days from sowing). The area of each plot was 7.5 m^2 (2.5 × 3 m). Nitrogen was added as ammonium nitrate (33.5% N), on three doses, the first dose (20%) at sowing, the second dose (50%) at the first irrigation (25 day from sowing), the third dose (30%) at the following irrigation (53 days from sowing). Phosphorus was applied as mono super phosphate (15.5% P_2O_5) at the rate of 15.5 kg P_2O_5 fed^{-1} during the soil preparation. Potassium was applied as potassium sulphate (48% K_2O) at the rate 24 kg K_2O fed^{-1} at the first irrigation. The other agricultural practices were done as the recommendation of Ministry of Agriculture. The Collected soil samples were air dried, grinded, passed through a 2 mm sieve and thoroughly analyzed for some selected chemical properties (Page *et al*., 1982). The soil main characteristics, before planting of the two seasons, were represented in Table 1. The residual N, P and K after growing seasons were done according to Faizy *et al*. (2012). Plant samples were collected at the end of the experiment, oven dried at 70 ºC, grinded and wet digested using sulphoric-perchloric acids mixture (Chapman and Pratt 1961). Nitrogen content was determined in the digested solution using micro-Kjeldahl method (Page *et al*., 1982). Phosphorus was calorimetrically measured according to Snell and Snell (1967). Potassium was determined according to Jackson (1967).

TABLE 1. Physical and chemical analyses of the experimental soil (0-50 cm) before planting in the two seasons 2012/2013 and 2013/2014

Parameters	First season 2012/2013		Second season 2013/2014	
	0-25 cm	25-50 cm	0-25 cm	25-50 cm
Soil pH (1:2.5 soil water suspension)	8.10	8.50	7.95	8.30
EC, dS m^{-1} at 25°C*	5.20	4.60	4.50	4.70
Total carbonate, %	2.97	3.47	4.83	4.91
SP (%)	85.05	82.76	98.21	93.40
CEC, cmol/kg soil	42.00	38.50	35.00	32.00
Particle size distribution (%) and texture class				
Clay	52.00	50.20	48.49	52.80
Silt	23.80	27.60	28.60	26.70
Sand	24.20	22.20	22.91	20.50
Soil texture class	Clayey	Clayey	Clayey	Clayey
Organic matter (g kg^{-1})	18.2	16.5	16.5	11.7
Soluble cations and anions ,meq/L				
Ca^{++}	13.55	17.30	15.20	16.40
Mg^{++}	2.94	4.25	2.74	4.10
Na^{+}	35.56	23.91	26.80	26.50
K^{+}	0.85	0.87	0.80	0.78
$CO_3^{=}$	ND	ND	ND	ND
HCO_3^{-}	5.10	4.81	4.74	4.40
Cl^{-}	17.81	24.60	27.50	29.20
$SO_4^{=}$	29.99	16.92	13.3	14.18
Available DTPA micronutrients, mg kg^{-1}				
Cu	2.80	0.98	3.10	4.70
Fe	1.18	2.60	3.24	3.82
Mn	4.30	4.80	5.20	4.01
Zn	1.04	1.23	0.68	0.84
Available macronutrients, mg kg^{-1}				
N	38.50	31.00	28.20	20.80
P	18.00	15.60	21.00	17.30
K	420.00	394.00	463.00	419.00
Total Nitrogen, %	0.08	0.12	0.12	0.16

Abbreviations: ND: Not detected, EC*: in soil paste extract, SP%: saturation percent, CEC: cation exchange capacity, OM: organic matter

Results and Discussion

Grain yield, straw yield and 1000 grain weight of wheat

Data presented in Table 2 show that, increasing nitrogen fertilizer levels from 0 to 40 and 80 kg N / fed significantly increased wheat grain yield (ardab fed^{-1}), straw yield (ton fed^{-1}) and 1000 grain weight (g). The highest grain values (23.70 and 24.31) were in the first and second season. The straw yield ranged from 3.5 to 3.8 ton fed^{-1} in the first and second season, respectively. The highest 1000 grain weight were obtained with the 80 kg N fed $^{-1}$ treatment, it may be due to the effect of N which was one of the major macronutrients for the plants, which plant structural and functional protein. On the other hand the lowest values were obtained with control the treatment. The trend of obtained these data are agree with those obtained by Sebastiano *et al*. (2005) and Ahmed *et al*. (2011) who concluded that nitrogen plays a key role in plant nutrition. The management of N is an extremely important of crop production. In respect to form of tested chelates , data in Table 2 show that humic was significantly effects higher on grain yield (16.08 and 16.55 ardab fed^{-1}), straw yield (3.32 and 3.06 ton fed^{-1}) and 1000 grain weight (49.15 and 47.51 gm) in the first and second seasons , respectively, obtained the values with EDTA form. Similar trends were reported by El-Saady, (2012) and Gad El-Hak *et al*. (2012).

TABLE 2. Effect of nitrogen fertilizer rates, forms of chelated and different micronutrients concentration on amounts of grain yield, straw yield and 1000 grain weight of wheat

Treatments	Grain yield, (ardab/feddan)		Straw yield, (ton/feddan)		1000 Grain weight (g)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
N-levels (kg N/fed)						
0	6.51 c	7.46 c	2.01 c	1.86 c	36.47 c	34.08 c
40	14.49 b	14.43 b	3.03 b	2.78 b	42.80 b	41.74 b
80	23.70 a	24.31 a	3.78 a	3.45 a	52.64 a	52.11 a
Form of chelate						
EDTA	13.73 b	14.24 b	2.56 b	2.34 b	38.80 b	37.78 b
Humic	16.08 a	16.55 a	3.32 a	3.06 a	49.15 a	47.51 a
Micronutrient						
Control	14.29 e	15.01f	2.77e	2.51d	42.23 d	40.76 e
Zn1	15.18cd	15.44bcd	2.99bc	2.72c	44.87 ab	42.86 bc
Zn2	15.63 a	15.76a	3.13a	2.82b	45.46 a	44.51 a
Mn1	15.26bc	15.25def	2.93cd	2.92a	43.62 c	43.02 b
Mn2	15.63a	15.65abc	3.02abc	3.01a	44.66 ab	44.16 a

Ardab=150 Kg, Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L,
Zn_1=30 mg/L, Zn_2=50 mg/L ,Cu_1=30 mg/L , Cu_2=50 mg/L.

Micronutrients spraying significantly affected wheat grain and straw yields as well as yield components (Table 2).The highest grain yield in the first and second season were obtained with spray Zn_2 (15.63 and 15.76 ardab fed^{-1}). The highest straw yield (3.13 ton fed^{-1}) in the first season was obtained with Zn_2 while in the second season 3.02 ton fed^{-1} with Mn_2. The highest values of 1000-grain weight (45.46 and 44.51gm) were obtained with Zn_2.It may be affected by decreasing of soil available Zn to plant need. The high response of wheat yield components to Zn, suggests the importance of this element to wheat cultivation in north delta soils. Similar trends were reported by Cakmak (2008), Zeidan *et al*. (2010) and Daneshbakhsh *et al*. (2013).

N-concentration (%) in grain and straw yield of wheat

Data presented in Table 3 show that, increasing Nitrogen fertilizer levels produced a significant affected on wheat grain in both tested seasons. Obvious increase of grain N percentage was detected with increasing nitrogen fertilizer levels to 80 Kg N fed^{-1}. The highest N% (2.01 and 2.02%) in the first and second season, respectively were obtained with 80 Kg N fed^{-1}, where the increasing N levels led to increase the available –N to plants .the obtained of these results were agree with those obtained by Gholami *et al*. (2011) and Woyema *et al*. (2012). A significant effect was observed with the N percent in grain and straw of wheat in both seasons (Table 3). Application of humic was increased the N% values (1.74 and 1.78 %) in grains and (0.43 and 0.37 %)in the straw . where the organic substances enhance plant absorption of the nutrients. Similar trends were reported by Khaled & Hassan (2011), El- Bassiouny *et al.* (2014) and Wojlkowiak *et al.* (2014).

Zinc significantly increased Nitrogen percent of wheat grain (1.69 and 1.69%) in both seasons .Also, this high nitrogen content might indicate meet the protein content in grains yield an this is very important to Egypt because it increase the nutrition on value of grains in comparison with meet protein N% in wheat straw significantly affected by micronutrients type and its concentration , where Mn_2 had the highest N% of wheat straw (0.67 and 0.35%) in the first and second season, respectively. Similar trends were reported by Potarzycki & Grzebisz (2009), El-Fouly *et al*. (2011) and El- Saady (2012) who concluded that zinc exerts a great influence on basic plant life processes such as nitrogen metabolism, uptake of N and protein quality and photosynthesis. This is an important result with respect to show as it increases the protein content of the main feed of animals in Egypt.

TABLE 3. Effect of nitrogen fertilizer rates forms of chelated and different micronutrients concentration on N-percentage in grain and straw yield of wheat plants

Treatments	N-concentration in grain (%)		N-concentration in straw (%)	
	2012/13	2013/14	2012/13	2013/14
N-level (Kg N/fed)				
0	1.290 c	1.354 c	0.3074 b	0.3157 c
40	1.605 b	1.617 b	0.3476 ab	0.3476 b
80	2.011 a	2.022 a	0.3778 a	0.3828 a
Form of chelate				
EDTA	1.53b	1.55b	0.32b	0.33b
Humic	1.74a	1.78a	0.43a	0.37a
Micronutrient content				
Control	1.593 d	1.593 d	0.3250 b	0.3289 d
Zn1	1.682 a	1.682 a	0.3439 b	0.3533 ab
Zn2	1.695 a	1.695 a	0.3450 b	0.3539 ab
Mn1	1.683 a	1.683 a	0.3400 b	0.3489 bc
Mn2	1.689 a	1.689 a	0.6789 a	0.3567 a

Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L,
Zn_1=30 mg/L, Zn_2=50 mg/L ,Cu_1=30 mg/L , Cu_2=50 mg/L.

P-concentration in grain and straw yield of wheat

Data presented in Table 4 show that, nitrogen fertilizer levels high significantly affected of P% in wheat grain in the second season only. In the second season, Increasing of grain P% was detected with increasing nitrogen fertilizer levels to 80 kg N fed^{-1}. The highest P content (0.41%) in the second season only were obtained with 80 Kg N fed^{-1}.this may be due to increasing N levels led to stimulating effect of N and P this might be due to the long term effect of adding P in the second year. Straw P% was highly significant in the first season than the second season. The obtained data were agreed with those obtained by Ahmed *et al*. (2011) and Jamal *et al*. (2006). Chelate forms significantly affected P% of wheat in the second season of wheat grain and the first season of wheat straw as shown in Table 4. The humic effect of on P% was higher in the grain and straw in the first season only. Similar trends were reported by Khaled & Hassan (2011) and El- Bassiouny *et al*. (2014). Manganese significantly increased P% of wheat grain (0.38%) in the second season only. Phosphorus %of wheat straw was not significant in both seasons. The same trends were reported by El-Saady (2012) and El-Fouly *et al*. (2011).

TABLE 4. Effect of nitrogen fertilizers rates, forms of chelated and different micronutrients concentration on P-percentage in grain and straw yield of wheat plants

Treatments	P-concentration in grain (%)		P-concentration in straw (%)	
	2012/13	2013/14	2012/13	2013/14
N-level Kg N/fed				
0	0.34 a	0.34 c	0.10 c	0.10 a
40	0.43 a	0.36 b	0.11 b	0.11 a
80	0.43 a	0.42 a	0.13 a	0.35 a
Form of chelate				
Humic	0.44 a	0.40 a	0.12 a	0.13 a
EDTA	0.43 a	0.41 a	0.13 a	0.12 a
Micronutrient conc.				
Control	0.35 b	0.35 c	0.10 b	0.10 b
Mn1	0.38 b	0.38 ab	0.11 a	0.12 b
Mn2	0.58 a	0.38 ab	0.12 a	0.12 b

Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L, *K-concentration (%) in grain and straw yield of wheat*

Data presented in Table 5 showed that, nitrogen fertilizer levels high significantly affected K content of wheat grains in both tested seasons. Obvious increase of grain K content was detected with increasing nitrogen fertilizer levels to 80 Kg N fed^{-1}. The highest K percent in wheat grains (0.49 and 0.50 %) in the first and second season, respectively were obtained under addition of 80 Kg N fed^{-1}. This effect it may be due to increasing N levels led to increase the availability of K to wheat plants. The highest K% in wheat straw (1.28 and 1.49 %) were obvious in both two seasons. the trend of these obtained data were agree with those obtained by Gholami *et al*. (2011) and Woyema *et al*. (2012).

Chelated forms produced a significant affected on K- percentage of wheat grain and straw in both tested seasons Table (5). Humic exert the higher K% (0.44 and 0.45 %) in grains and (1.20 and 1.43 %) in the straw yield. It may be due to humus stimulating effect on absorption of the nutrients. Similar trends were reported by Khaled & Hassan (2011) and El-Bassiouny *et al*. (2014). Manganese application significantly increased K content of wheat grains (0.43 and 0.44 %) in both tested seasons. Potassium percentage in wheat straw also significantly affected with type and concentrations of applied micronutrients. Also the highest K content of wheat straw (1.17 and 1.39 %) were in the first and second seasons under application of Fe_2 .Similar trends were detected by Potarzycki & Grzebisz (2009), El-Fouly *et al*. (2011) and El-Saady (2012).

TABLE 5. Effect of nitrogen fertilizers rates, forms of chelated and different micronutrients concentration on K-percentage in grain and straw yield of wheat plants

Treatments	K-concentration in grain (%)		K-concentration in straw (%)	
	2012/13	2013/14	2012/13	2013/14
N-level Kg N/fed				
0	0.33 c	0.36 c	1.00 c	1.23 c
40	0.40 b	0.41 b	1.10 b	1.37 b
80	0.49 a	0.50 a	1.28 a	1.49 a
Form of chelate				
EDTA	0.44 a	0.45 a	1.20 a	1.43a
Humic	0.54 b	0.55 b	1.44 b	1.55 b
Micronutrient conc.				
Control	0.36 e	0.37 d	1.04 b	1.27 c
Fe1	0.39 d	0.41 c	1.15 a	1.36 b
Fe2	0.40 c	0.42 b	1.17 a	1.39 ab
Mn1	0.42 b	0.43 a	1.12 a	1.37 ab
Mn2	0.43 a	0.44 a	1.15 a	1.39 a

Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L,
Zn_1=30 mg/L, Zn_2=50 mg/L ,Cu_1=30 mg/L , Cu_2=50 mg/L.

Nitrogen, P and K uptake of wheat grain yield

Nitrogen uptake

Data in Table 6 showed that N- uptake by grains were increased by about (86.18 and 87.23 kg/fed) in both tested seasons ,as effected by increasing N levels up to 80 Kg N/ fed .Similar trends were reported by Koch and Mengel (1977). Chelate forms significantly affected N-uptake of wheat grain in both seasons Table 6. Application of humic increased N-uptake values with grains (60.31 and 58.45 kg/fed) in the two growing seasons. Similar trends were reported by Kanani (1996). Also, Manganese application significantly increased N-uptake of wheat grain (63.71 and 53.48 kg/fed) in both two growing seasons. Similar trends were reported by Potarzycki & Grzebisz (2009), El-Fouly *et al*. (2011) and El-Saady (2012).

Phosphorus uptake

Data in Table 6 showed that P- uptake by grains were increased by about (20.14 and 19.97 kg/fed) in both two seasons as affected by increasing N addition up to 80 Kg N/ fed .Similar trends were reported by Koch and Mengel (1977). Chelate forms significantly affected P-uptake of wheat grain in both seasons Table (6). Generally, the application of humic was increased P-uptake values with grains (15.32 and 14.13 kg/fed) in the two growing seasons than the EDTA form. Similar trends were reported by Kanani (1996). The application of Mn_2 significantly increased P-uptake of wheat grain (17.99 and 12.84 kg/fed) in both seasons. Similar trends were reported by El-Fouly et al. (2011) and El-Saady (2012).

Potassiume uptake:

Data in Table (6) showed that K- uptake by grains was increased by about (22.38 and 69.77 kg/fed) in both growing seasons .affected by increasing N up to 80 Kg N/ fed .Similar trends were reported by Khattab et al. (1996) Chelate forms significantly affected K-uptake of wheat grain in both seasons Table (6). On the other hand, the addition of humic was increased the uptake values of N grains (15.70 and 56.33 kg/fed) in the two growing seasons. Similar trends were reported by Kanani(1996). Application of Mn_2 significantly increased K-uptake of wheat grain (14.54 and 53.84 kg/fed.) in both seasons. Similar trends were reported by El-Fouly *et al*. (2011) and El-Saady (2012).

TABLE 6. Effect of nitrogen fertilizers rates, forms of chelated and different micronutrients concentration on N, P and K uptake of grain yield of wheat

Treatments	N-uptake (kg/fed.)		P-uptake (kg/fed.)		K-uptake (kg/fed.)	
	2012/13	2013/14	2012/13	2013/14	2012/13	2013/14
N-level Kg N/fed						
0	18.95 c	21.29 c	5.34 c	5.85 c	5.26 c	27.11 c
40	49.32 b	44.85 b	12.95 b	10.97 b	12.24 b	47.36 b
80	86.18 a	87.23 a	20.14 a	19.97 a	22.38 a	69.77 a
Form of chelate						
EDTA	42.66b	43.79b	10.30b	10.40b	10.88b	39.82b
Humic	60.31a	58.45a	15.32a	14.13a	15.70a	56.33a
Micronutrient conc.						
Control	45.83 d	47.49 e	10.89 b	10.85 c	11.05 f	41.44 f
Mn1	50.74bcd	52.04 b	12.65 b	12.65 a	13.85 b	51.84 b
Mn2	63.71 a	53.48 a	17.99 a	12.84 a	14.54 a	53.84 a

Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L,
Zn_1=30 mg/L, Zn_2=50 mg/L ,Cu_1=30 mg/L , Cu_2=50 mg/L.

Macronutrients (N, P and K) available of soil

Available nitrogen in soil

Data in Table (7) showed the values of Available -N after wheat harvesting. The highest value of available -N in both seasons were (24.68 mg N /kg and 24.65 mg N/kg) with N_{80}treatment .These data agree with those obtained by (Nasr El-Din 2001 and Alan *et al*. 2007). Available nitrogen was significantly affected by chelated forms after wheat harvesting in both seasons Table (7). Also, the addition of humic exert is more efficiency for increasing N-available values (22.45 and 22.84 mg N/kg) in the two growing seasons. Similar trends were reported by Potarzycki and Grzebisz (2009), El-Fouly *et al*. (2011) and El-Saady (2012). Addition of Zn_2 increased N-available after wheat harvesting (21.24 and 21.48 mg N/kg) in both seasons. Similar trends were reported by El-Fouly *et al*. (2011) and El-Saady (2012).

Available Phosphorus in soil

Data in Table 7 showed the values of soil Available P after wheat harvesting. The highest values of available P in both seasons were (17.83 mg P /kg and 15.92 mg P/kg) under N_{80} treatment. These results agree with those obtained by (Nasr El-din 2001 and Alan *et al*., 2007). Phosphorus available was affected significant by Chelated forms in both seasons (Table 7). Humic form exert a tendency to increase P-available values (14.12 and 12.97 mg P/kg) in the two growing seasons. Similar results were reported by El-Fouly *et al*. (2011). The treatment of Fe_2 was increased P-available significantly after wheat harvesting (13.79 and 12.12 mg P/kg) in both two seasons the amounts of available P in soil after wheat harvesting significantly affected by micronutrients type and concentration. Similar trends were reported by El-Fouly et al. (2011) and El-Saady (2012).

Available Potassium in soil

Data in Table 7 showed the values of available –K in tested soil after wheat harvesting. The ranged from (287.19 mg K/kg to 278.01 mg K / kg) under N_{80}treatment .These trends were agree with those obtained by (Faizy *et al*., 2012) trends were reported by El-Fouly *et al.* (2011) and El-Saady (2012).

Application of different chelate forms significantly affected K-available after wheat harvesting in both seasons (Table 7). Potassium availability was significantly higher with humic forms (266.34 and 256.68 mg K/kg) in the two growing seasons. Similar trends were reported by El-Fouly *et al*. (2011). Application of Fe_2 gave highly significant values of soil available-K after wheat harvesting (261.1 mg K/kg) in the first season. Similar

TABLE 7. Effect of nitrogen fertilizers rates, forms of chelated and different micronutrients concentration on available N,P and K of soil after wheat harvesting

Treatments	Available nitrogen (mg/kg)		Available phosphorus (mg/kg)		Available potassium (mg/kg)	
	2012/13	2012/13	2012/13	2013/14	2013/14	2013/14
N-level Kg N/fed						
0	17.85 c	18.52 c	9.17 c	7.89c	217.35c	211.69c
40	20.02 b	20.36 b	13.31 b	12.16b	274.59b	258.76b
80	24.68 a	24.65 a	17.83 a	15.92a	287.19a	278.01a
Form of chelate						
EDTA	19.25 b	19.52 b	12.74 b	11.00b	253.08b	242.29b
Humic	22.45 a	22.84 a	14.12 a	12.97a	266.34a	256.68a
Micronutrient conc.						
Control	19.58 c	19.72 d	12.68 c	11.67 c	255.1 d	243.6ab
Fe1	20.92 ab	21.19 c	13.53 b	12.07 a	260.2ab	247.6ab
Fe2	21.20 a	21.44 a	13.79 a	12.12 a	262.1 a	247.5ab
Zn1	21.18 a	21.33abc	13.48 b	11.98ab	261.4ab	258.5 a
Zn2	21.24 a	21.49 a	13.52 b	12.07 a	262.1 a	257.0 a

Fe_1=200 mg/L ,Fe_2=300 mg/L ,Mn_1=70 mg/L ,Mn_2=100 mg/L,
Zn_1=30 mg/L, Zn_2=50 mg/L ,Cu_1=30 mg/L , Cu_2=50 mg/L.

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دراسة إستجابة القمح للتسميد الأزوتي والعناصر الصغري وأثر ذلك علي محتوى التربة من بعض العناصر الكبرى الميسرة

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أجريت تجربة حقلية في موسمين متتاليين 2013/2012 ، 2014/2013م لمزرعة كلية الزراعه – جامعة كفرالشيخ بهدف دراسة استجابة محصول القمح صنف مصر 1 لمستويات مختلفة من التسميد النيتروجيني وبعض الصور المخلبية للعناصر الصغري بتركيزات مختلفة وذلك لدراسة أثرها علي محصول القمح وبعض خصائص التربة تم استخدام تصميم احصائي في قطع منشقة مرتين لثلاث مقررات القطعة الرئيسية تمثل ثلاث مستويات للنيتروجين (0 ، 40 ، 80 كجم ن / فدان) والقطعة المنشقة الاولي تمثل صورتين مخلبيتين لكل من مادة الهيوميك واديتا تم استخدامهم كتسميد ورقي علي فترات مختلفة في مراحل نمو النبات والقطعه المنشقة الثانية تمثل أربع صور للعناصر الصغري كل عنصر منهم بتركيزين وهم : الحديد (تركيز 200 ، 300 مللجرام / لتر) ، المنجنيز (تركيز 70 ، 100 مللجرام / لتر) ، الزنك (تركيز 30 ، 50 مللجرام / لتر) ، النحاس (تركيز 30 ، 50 مللجرام / لتر) مع معاملة كنترول بدون اضافات .

ان الهدف الاساسى من الدراسة المقدمة هو دراسة تاثير استخدام مستويات مختلفة من التسميد الازوتى و بعض الصور المخلبية للعناصر الصغرى المضافة كتسميد ورقى على :-
-1 بعض خصائص الارض الكيمائية .
-2 المحصول ومكونات المحصول لنبات القمح .
-3 امتصاص القمح لكل من عنصر النيتروجين والفوسفور والبوتاسيوم .

ولقد اوضحت النتائج ان :-
افضل معاملة هى المعدل 80 كجم نيتروجين / فدان مع استخدام التركيز الثانى من الزنك والمنجنيز على صورة حامض الهيوميك حيث اعطى اعلى انتاجية لمحصول القمح بالاضافة لتحسين خصوبة التربة تحت ظروف الدراسة التى اجريت على ارض طينية ملحية.