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The Combined Effect of Urea and Organic Acid on Some Soil Properties, Yield and Nutrient Uptake by Wheat Crop

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FIELD experiment was carried out during two successive seasons (2012-2013 and 2013-2014) to study the effect of organic acids and N-mineral fertilizers as well as their combination, on some soil properties**,** yield and nutrient uptake of wheat (*Triticum aestivum L.*) plants. In this study, eight treatments were used as follows: T1) Control (without addition); T2) 75 Kg N fed.$^{-1}$; T3) 75 Kg N fed^{-1} coated with humic acid; T4) 75 Kg N fed.$^{-1}$ coated with fulvic acid; T5) 75 Kg N fed.$^{-1}$ + 4 liter humic acid as a soil addition ; T6) 75 Kg N fed.$^{-1}$ + 4 liter fulvic acid as a soil addition; T7) 75 Kg N fed.$^{-1}$ + 4 liter humic acid as a foliar application and T8) 75Kg N fed.$^{-1}$ + 4 liter fulvic acid as a foliar application. Results indicated that the soil organic matter (OM) and available N, P and K increased with the combined application of mineral N with organic acid over application of mineral N alone. The soil pH value decreased with organic acids applied as a soil addition compared with a foliar addition. The higher values of N uptake by grain yield and protein were 71.76 and 409.05 kg fed^{-1} in T3, respectively. The value of nitrogen used efficiency (NUE) ranged from 31.68 to 41.85 during the two seasons. The application of organic acid combined with N-mineral fertilizers gave better results in increasing the yield of wheat especially when nitrogen fertilizers coating with humic acid. Application of organic acid to the soil increased the yield by 2.56% and 10.21% in the first and second season, respectively as compare to urea alone. Based on the results of the current study, the combinations of N-mineral and organic acids can be considered as an integrated nutrient management to improve the soil fertility and wheat yield.

Keywords: Organic acid, Humic acid, Fulvic acid, Coating, Foliar, Wheat.

Wheat (*Triticum aestivum* L.) is considered one of the most important cereal crops in the world and in Egypt. The amount needed from it is greater than that locally produced. Therefore, increasing its productivity as well as cultivated area is highly recommended. Wheat requires specific amount of certain nutrients in specific form at appropriate time, for their growth and development (Sajid *et al*., 2008). Egypt lies in arid and semiarid regions which, soils are characterized with low organic matter, high pH and high $CaCO_3$ (Malakouti, 2008). Under such conditions, soil application of the nutrients can be very expensive. Nitrogen is the most important plant nutrient needed to obtain high wheat yields in Egypt. Nitrogen fertilizer form extensively used in the world agriculture is urea. Urea is as nitrogenous fertilizer, widely used in agriculture because of its high nitrogen content (45%). However, about 20–70% of the applied urea fertilizer is lost to the environment, causing serious pollution and increasing costs. The losses are due to leaching, decomposition and ammonium volatilization in soil, handling and storage (Shaviv and Mikkelsen, 1993). Nitrogen losses from urea can be minimized through the reduction of urease activity which will further delay urea hydrolysis. Similarly, urea fertilizer is subject to NH_3 volatilization through the activity of urease enzyme which is found in soils all over the world. There are many products that have been developed to delay urea hydrolysis or other N transformation processes to synchronize availability of N with the plant needs. The controlled-release technology, by coating, can be utilized to increase the efficiency of urea fertilizer. The coating of urea has been studied by many investigators, with different techniques (rotating drum, fluidized bed, spouted bed) and various materials (sulfur, resin, polymers). Many works have reported the improvement of the coating quality by using sulfur as coating agent (Ayub *et al.*, 2001).

Humic acid (HA) and fulvic acid (FA) represent two major fractions of humic substances (HS), while the latter generally shows higher chemical and physico-chemical activity compared with the former, and plays an important role in the acid- base buffering capacity of soil, and in the retention and release, biological availability, mobility of metal ions (Senesi and Loffredo, 2005). Humic substances are readily found in soils and influence plant growth both directly and indirectly (Cimrin and Yilmaz, 2005). They have indirect influences on plant growth because they can improve soil properties such as aggregation, aeration, permeability, water holding capacity, hormonal activity, microbial growth, organic matter (OM) mineralization, and solubilization and availability of microelements (*e.g.,* Fe, Zn, and Mn) and some macro elements (*e.g.,* K, Ca, and P) (Sharif *et al.,* 2002). Directly, they affect the processes associated with the uptake and transport of humic substances into the plant tissues (Nardi *et al.,* 2002). Humic substances improve yield and quality of a variety of plants, including grains (Ulukan, 2008). Humic substances improve soil fertility by modifying the physical, chemical, and biological conditions in soil.They affect the solubility of many nutrient elements by building complex forms or chelating with metal cations (Verlinden *et al.,* 2009).

Foliar feeding technique, as a particular way to supply nutrients could avoid these factors and results in rapid absorption. Foliar feeding of micronutrients generally is more effective and less costly (El-Fouly and El- Sayed, 1997). During the last decades, foliar feeding of nutrients has become an established procedure to increase yield and improve the quality of crop products (Röemheld and El-Fouly, 1999). This procedure can also improve nutrient utilization and lower environmental pollution through reducing the amount of fertilizers added to soil (Abou El-Nour, 2002). Khan and Mir (2002) found a significant effect of humic acids on yield and yield components of wheat. The activation of many processes accompanied emergency of primary root and the emergency of shoot. Metabolic changes due to permeability of humic acids into leaf cells, and improved the yield and yield components except protein. Therefore, the aim of this investigation was to study the combined effect of mineral N and organic acid and their application methods on some soil properties, fertilizer use efficiency, yield and nutrient uptake of wheat plants.

Materials and Methods

A field experiment was conducted at EL-Gemmieza Agriculture Research Station, El Gharbiah Governorate, Egypt (Middle Delta region 30⁰ 43- latitude and 31⁰ 07- longitude) during two successive seasons (2012-2013 and 2013 - 2014) to study the combined applicayion of mineral N and organic acid and their application methods on growth, yield , fertilizer use efficiency and chemical constituents of wheat yield. The physico-chemical analysis of the experimental soil according to Page (1982) is shown in Table 1.

TABLE 1. Some physical and chemical properties of the experimental field

Seasons	Particle size distribution,%			Texture class	EC_e dSm^{-1}	pH (1:2.5)	OM (%)	$CaCO_3$ (%)	Available nutrients ($mg\ kg^{-1}$)		
	Sand	Silt	Clay						N	P	K
1	9.1	31.2	59.7	Clayey	2.21	7.81	1.62	2.24	20	6.7	230
2	8.7	33.1	58.2	Clayey	2.19	7.93	1.77	2.26	18	6.3	219

Wheat (*Triticm aestivum* L. *cv. Gemmiza 9*.) plants were cultivated at 5 and 8 December 2012 and 2013 at seed rate 60 kg fed^{-1} with eight treatments. The treatments were as follows: T1) Control (without addition); T2) 75 Kg N $fed.^{-1}$; T3) 75 Kg N fed^{-1} coated with humic acid; T4) 75 Kg N $fed.^{-1}$ coated with fulvic acid; T5) 75 Kg N $fed.^{-1}$ + 4 liter humic acid as a soil addition ; T6) 75 Kg N $fed.^{-1}$ + 4 liter fulvic acid as a soil addition; T7) 75 Kg N $fed.^{-1}$ + 4 liter humic acid as a foliar application and T8) 75 Kg N $fed.^{-1}$ + 4 liter fulvic acid as a foliar application. The experimental field was prepared and then divided into 24 plots (3 m x3.5 m for each one plot). The experiment was arranged for randomized complete block design with three replicates.

Used humic and fulvic acids were extracted and prepared by Soil Fertility and Plant Nutrition Department, Sakha Agric. Res Station, Egypt. Some physical and chemical properties of humic and fulvic acids are shown in Table 2.

TABLE 2. Some composition of humic and fulvic acids used.

Variable units	Humic acid (40%)	Fulvic acid (28%)
N (%)	5.0	5.0
K_2O (%)	3.0	5.0
Mg (%)	0.5	0.5
Fe (mg kg^{-1})	4000	4000
Mn (mg kg^{-1})	1200	1200
Zn (mg kg^{-1})	600	600
Cu (mg kg^{-1})	200	200
Citric acid (%)	3.0	3.0

Coat urea glue and leave to minutes and then encapsulate with (4 Liter fed^{-1}) of organic acids and then deal experience as used by Lamyaa and Eskarous (2014) and added to soil at three doses; with grain planting and before the second and third irrigation. Humic and falvic acids were added to soil at rate of 4 Liter fed^{-1} at one dose with grain planting and the other treatments for foliar spray (4 Liter fed^{-1} of each organic acid) were done at three doses: the first at 45 day of sowing, the second was done at 60 day of sowing and the third at 90 day of sowing. The recommended dose of mineral fertilizer of nitrogen was added as urea (46.5%N) at rate (75 kg urea fed^{-1}) at three doses: one dose with grain sowing, second and third doses with the first and the second irrigation. Single super phosphate fertilizer (15.5% P_2O_5) was added at rate (100 kg super phosphate fed^{-1}) during the soil preparation, potassium sulphate fertilizer (48% K_2O) was added at rate (50 kg potassium sulphate fed $^{-1}$) at one dose with the first irrigation. At maturity of plants at 10 and 12 May 2013 and 2014, one meter square from each treatment was taken to calculate the grain yield (ton fed^{-1}), straw yield (ton fed^{-1}) and 100 grain weight (g). Straw and grain samples of each treatment were oven dried at 70° C to become constant weight, and this weight was recorded and kept for chemical analysis. N and P elements in straw and grain were determined according to the methods described by Page (1982).

N and P contents were determined in the digested samples according to Page, (1982). Protein content (kg fed^{-1}) was calculated by multiplying N% X 5.7 X yield kg fed^{-1}.

Fertilizer use efficiency (FUE) was calculated according to Doberman (2007):

$$FUE = \frac{\text{yield (kg fed}^{-1})}{\text{Fertilizer applied (kg fed}^{-1})}$$

N and P uptake (kg fed^{-1}) were calculated by the following equation:

$$\text{Element uptake (kg)} = \frac{\text{element (\%)} \times \text{dry yield kg}}{100}$$

Utilization rate (UR) of N and P fertilizer, was calculated according to Finck (1982) as used by Abd El-Kader (1998) as the following formula:

$$\text{UR\%} = \frac{\text{Total removal* - removed from soil reserves**}}{\text{Nutrient amount of applied fertilizer***}}$$

where: * plant uptake.
** The uptake of control treatment.
*** Quantity of nutrient in applied fertilizer.

Utilization efficiency was calculated according to the fowling equation (as used by Lamyaa, 2011):

$$\text{UE} = \frac{\text{Total yield (kg fed}^{-1}\text{)}}{\text{Utilization rate for the treatment x element applied}}$$

Available N was extracted by KCl and determined by using semi micro kjheldahl technique, available P was extracted by sodium biocarbonate 0.5M at pH 8.5 according to Olsen method and measured photometrically color using ammonium molybedate and available K was extracted by ammonium acetate and determined with flam photometr according to page (1982).

The results obtained for the two growing seasons were statistically analyzed according to Gomez and Gomez (1984). The significant differences among the means of the two seasons were tested using the least significante difference (L.S.D) at the 5% level of significance.

Results and Discussion

The combined effect of urea and organic acid on wheat yield parameter

A grain yield; straw yield and 100 grain weight were significantly increased by the different methods of organic acids application in both seasons (Table 3). Also, data indicate that, the method of coating urea with organic acids increased the grain and straw yield compared to the other methods and the treatment of urea coating with HA increased the grain, straw and 100 grain weight of wheat yield compared to urea coating with FA. The organic acids combined with N-mineral fertilizers gave better results in increasing the yield of wheat especially when nitrogen fertilizers coating with humic acid and application to the soil as it increases the yield by 2.56% and 10.21% in the first and second season, respectively relative to urea alone. The highest mean value of grain, straw yield and 100 grain weight (3.147, 6.559 ton fed^{-1} and 7.405g) were obtained with the treatment of urea coating with HA, respectively compared to the other treatments. But the lowest mean values of grain, straw yield and 100 grain weight (2.960, 5.499 ton fed^{-1} and 6.47 g) were obtained with the treatment which resaved 75 kg N only. The increment of grain and straw yield might be due to the composition of humic acid which is rich in different nutrients and the coating of urea helped to slowly dissolve in urea, which conserved of N to leach in soil and improvement in plant growth and dry matter compared to the other methods of N application. The coated urea with organic acids could help in increasing nutrient availability from applied and native source compared with the others methods such as mixed with the soil or application as a foliar. It could be observed from data in Table 8 that, availability of N, P and K in the soil which increased after organic acids application which creates suitable conditions for plant growth and enhanced grain yield, straw yield and 100 grain weight. The amount or rate of humic molecules to enhance NH_4 recovery in soil can indirectly promote plant growth.Similar findings have been reported by Omar and Abo Bakr (1995).

TABLE 3. The combined effect of urea and organic acid on grain yield, straw yield and 100 grain weight of wheat plants.

Treatments	Grain (t/fed)			Straw (t/fed)			100 grain (g)		
	S1	**S2**	**Mean**	**S1**	**S2**	**Mean**	**S1**	**S2**	**Mean**
T1	2.010	2.754	2.38	3.191	3.388	3.29	5.990	6.067	6.03
T2	3.010	2.909	2.96	5.494	5.503	5.50	6.507	6.407	6.91
T3	3.087	3.206	3.15	6.111	7.006	6.56	7.013	7.797	7.41
T4	3.066	3.024	3.05	5.883	6.076	5.98	6.893	6.930	6.41
T5	3.080	3.108	3.09	6.093	6.412	6.25	7.087	7.633	7.36
T6	3.073	3.087	3.08	5.978	6.090	6.03	6.977	7.100	7.04
T7	3.103	2.975	3.04	5.944	5.684	5.81	6.563	6.577	6.57
T8	3.068	2.947	3.01	5.516	5.670	5.59	6.547	6.560	6.55
LSD	).1108	0.1356		0.3955	).2538		0.3756	0.2656	

S1: season 1, S2: season2

T1) Control (without addition); T2) 75Kg N fed.$^{-1}$; T3) 75 Kg N fed^{-1} coating with 4L humic acid; T4) 75Kg N fed.$^{-1}$ coating with 4L falvic acid; T5) 75Kg N fed.$^{-1}$ +4Lhumic acid as a soil addition ; T6) 75Kg N fed.$^{-1}$ +4Lfalvic acid as a soil addition; T7) 75Kg N fed.$^{-1}$ +4Lhumic acid as a foliar addition and T8) 75Kg N fed.$^{-1}$ +4Lfalvic acid as a foliar addition. one feddan = 4200 m^2

The combined effect of urea and organic acid on N and P contents in grain and straw of wheat yield

N content (kg fed^{-1}) in grain and straw of wheat plants was significantly affected by different methods application of organic acids in both seasons (Table 4). The highest mean values of N content in grain and straw were (71.76 and 40.91 kg fed^{-1}) obtained with treatment which resaved 75 kg N urea coating with 4L HA, respectively. The lowest mean values of N content in grain and straw were (50.06 and 22.19 kg fed-1) obtained with the treatment which resaved 75 kg

N of urea alone, respectively. These results confirmed with results of grain and straw yield (Table 3) and concentration of N in grain and straw. The increment of N content with application of organic acid compared without addition reflected the N mineralization in soil especially in the second season. Organic acids application increased the ability of plants to maintain higher nitrogen contents along with other micro and micronutrients (Nikbakht *et al.,* 2008). These results are found by Tahir *et al.* (2011) and Tahira *et al.* (2013) who reported that, HA is emerging as the most prominent biofertilizer in enhancing morpho-physiological and biochemical aspect of plant growth. The application of urea fertilizer mixed with humic acid increased the nitrogen uptake by plants as compared with that fertilized by urea only (Lamyaa and Eskarous , 2014).

TABLE 4. The combined effect of urea and organic acid on N contents in grain, straw and total N uptake of wheat plants

Treatments	N content Grain (Kg fed^{-1})			N content Straw (Kg fed^{-1})			Total N uptake (Kg fed^{-1})		
	S1	**S2**	**Mean**	**S1**	**S2**	**Mean**	**S1**	**S2**	**Mean**
T1	31.62	40.75	36.19	12.25	12.89	12.57	43.87	53.64	48.76
T2	50.47	49.65	50.06	22.36	22.02	22.19	72.82	71.67	72.25
T3	69.26	74.26	71.76	39.32	42.49	40.91	108.6	116.8	112.70
T4	58.46	57.75	58.11	31.55	29.97	30.76	90.01	87.73	88.87
T5	68.17	62.16	65.17	36.96	36.97	36.97	105.1	99.13	102.12
T6	60.10	61.02	60.56	35.07	33.30	34.19	95.14	94.32	94.73
T7	55.97	55.03	55.50	27.17	25.82	26.50	83.14	80.85	81.99
T8	52.45	52.56	52.51	24.22	23.69	23.96	76.66	76.25	76.46
LSD	2.550	5.437		2.433	1.681		4.124	6.067	

Also, data in Table 5 show that P content (kg fed^{-1}) in grain , straw and total P content were significantly increased with the different methods application of organic acids in both seasons. The same treatment (75 kg N of urea coating with 4 L HA) has done the highest mean value of P content in grain and straw (9.39 and 2.42 kg fed^{-1}) respectively, and the lowest mean value of P content in grain and straw (6.17 and 1.26 kg fed^{-1}) obtained with treatment which resaved 75 kg N of urea only respectively. These results mean that, HA increases the nutrient uptake and accumulation which is in harmony with the results obtained by Tahir *et al.* (2011) who reported that, organic material may indirectly influence N and P supply to plants through promoting growth and activity of N mineralizing and P solubilizing organisms in soils.

TABLE 5. The combined effect of urea and organic acid on P contents in grain, straw and total P uptake of wheat plants

Treatments	P content in grain (Kg fed^{-1})			P content in straw (Kg fed^{-1})			Total P uptake (Kg fed^{-1})		
	S1	**S2**	**Mean**	**S1**	**S2**	**Mean**	**S1**	**S2**	**Mean**
T1	4.087	5.603	4.85	0.6933	0.7033 G	0.70	4.770	6.307	5.54
T2	6.32	6.013	6.17	1.300	1.213 F	1.26	7.620	7.227	7.42
T3	9.473	9.297	9.39	2.383	2.450 A	2.42	11.86	11.75	11.81
T4	7.057	7.463	7.26	1.787	1.723 D	1.76	8.843	9.187	9.02
T5	8.213	8.803	8.61	2.337	2.113 B	2.23	10.55	10.92	10.74
T6	7.787	8.127	7.96	2.093	1.870 C	1.98	9.880	9.997	9.39
T7	7.067	6.743	6.91	1.517	1.403 E	1.46	8.853	8.147	8.50
T8	6.24	6.287	6.26	1.437	1.280 F	1.36	7.677	7.573	7.63
LSD	0.8139	0.3797		0.1661	0.1108		0.8082	0.45.33	

The combined effect of urea and organic acid on protein, N and P use efficiency

Data in Table 6 showed that, protein (kg fed^{-1}), NUE and PUE were significantly increased with the different application methods of organic acids in both seasons. The maximum mean values of protein, NUE and PUE were (409.1, 41.85 and 226.43), respectively obtained with the treatment 75 kg N of urea coating with 4 L HA, followed by treatment of 75 kg N of urea and 4 L HA as a soil addition (371.4, 41.16 and 206.25), respectively. Whereas, the minimum mean values of protein, NUE and PUE (285.35, 39.36 and 192.30), respectively obtained with the treatment which resaved 75 kg N of urea only. Application of urea mixed with 2% humic acid could provide better urea use efficiency when urea is mixed with an appropriate amount of HA (Lamyaa and Eskarous, 2014). These results depended on the concentration of N and P in grain, the quantity of N and P addition to the soil and the grain yield of wheat obtained. Many investigators reported that the use of urea mixed with humic acid reduced N losses and increased N uptake and thus increased N use efficiency (Zaman *et al.*, 2009). Similar results were obtained by Lamyaa and Eskarous (2014) who reported that, humic acid markedly increased the absorption rate of N fertilizer.

The combined effect of urea and organic acid on utilization rate (UR) and utilization efficiency (UE) of N and P

Data in Table 7 showed that, the mean values of NUR varied from (85.21 to 32.08) and PUE varied from (41.79 to 12.6) and the data in the first season was high compared with the data in the second season, this may be due to the quantity of elements added to soil and the residual effect of the first season. The highest mean values of NUR and PUR (85.21 and 41.79), respectively were obtained with the treatment which resaved 75 kg N of urea coating with 4 L HA. Whereas the lowest mean values of NUR and PUR (32.08 and 12.60), respectively were obtained with the treatment of 75 kg N of urea alone. These results confirmed the data of grain yield, NUE and PUE.

TABLE 6. The combined effect of urea and organic acid on on N and p use efficiency and protein of wheat plants

Treatments	Protein			NUE			PUE		
	S1	S2	Mean	S1	S2	Mean	S1	S2	Mean
T1	180.2	232.3	206.25	26.74	36.62	31.68	134.0	183.6	158.50
T2	287.7	283.0	285.35	40.03	38.69	39.36	200.67	183.93	192.30
T3	394.8	423.3	409.05	41.06	42.64	41.85	205.8	247.07	226.43
T4	333.2	329.2	331.20	40.78	40.22	40.50	204.4	201.6	203.00
T5	388.5	354.3	371.40	40.97	41.34	41.16	205.3	207.2	206.25
T6	342.6	347.8	345.20	40.87	41.06	40.97	204.67	205.8	205.23
T7	319.0	313.7	316.35	40.31	39.57	39.94	202.07	198.33	200.20
T8	299.0	299.6	299.30	40.17	39.19	39.68	204.67	198.27	201.47
LSD	14.54	30.99		1.382	1.78				

TABLE 7. The combined effect of urea and organic acid on utilization rate (UR) and utilization efficiency (UE) of N and P in grain of wheat plants

Treatments	N Utilization rate (%)		P Utilization rate (%)		N Utilization efficiency		P utilization efficiency	
	S1	S2	S1	S2	S1	S2	S1	S2
T1								
T2	38.6	25.57	19.0	6.2	103.97	151.69	1056.14	3232.22
T3	86.27	84.15	47.27	36.33	47.69	50.80	435.37	588.31
T4	61.52	45.45	27.13	19.27	66.45	88.71	753.41	1046.19
T5	81.68	60.65	45.27	30.73	50.28	68.33	199.32	674.26
T6	68.36	54.24	33.33	24.6	59.94	75.88	614.66	836.59
T7	52.36	36.28	22.2	12.33	77.18	109.33	910.21	1608.54
T8	43.72	30.15	19.47	8.47	92.10	131.52	1034.07	2340.81

With regard to the N utilization efficiency (NUE) and P utilization efficiency (PUE), data in second season was higher than the first season in contrast of UR this may be due to the equation of calculation depended on UR and the quantity of element applied. The highest mean values of NUE and PUE (127.83 and 2144.2), respectively were obtained with treatment of 75 kg N of urea alone because the UR in this treatment was the lowest value compared with the other treatments. Whereas, the lowest mean values of NUE and PUE were (49.25 and 511.84), respectively obtained with treatment of 75 kg N of urea coating with 4 L HA depending on high value of UR. Liquid form of humic acid could play an important role in enhancing urea efficiency; similar results were obtained by Lamyaa and Eskarous (2014).

The combined effect of urea and organic acid on some available nutrients after wheat harvested

Data in Table 8 showed a slow decrease in pH with the different methods of addition of organic acids compared with control. But the addition of organic acid increased EC, OM, available N, P and K compared with the control treatment (without addition). The highest mean value of EC, OM, N, P and K were (2.28 dSm^{-1}, 2.1%, 29.30 mg kg^{-1}, 10.21 mg kg^{-1} and 335 mg kg^{-1}), respectively obtained with treatment which resaved 75 kg N of urea coating with 4 L HA. But the lowest mean values (2.24 dSm^{-1}, 1.76%, 21.20 mg kg^{-1}, 7.70 mg kg^{-1} and 282 mg kg^{-1}), respectively were obtained with treatment which resaved 75 kg N of urea alone. The increment of EC, OM, available N, P and K in the treatment which resaved organic acid compared to urea alone may be due to the composition of organic acid and the combination of urea with humic acid which significantly reduced urea hydrolysis (Nasima *et al.*, 2010).

These results confirmed with those obtained by Bundy *et al* . (1992) who indicate the role of (HA) in reducing ammonia losses by either leaching or volatilization, in addition to improving soil characteristics.

TABLE 8 . The combined effect of urea and organic acid on some available nutrients after wheat harvested

Treatments	pH (1:2.5)		ECe (dSm^{-1})		OM(%)		Available macronutrients ($mgkg^{-1}$)					
							N		P		K	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
T1	7.8	7.8	2.18	2.2	1.6	1.73	20.0	20.1	7.69	7.7	275	290
T2	7.8	7.82	2.24	2.25	1.72	1.80	21.1	21.33	7.6	7.79	277	287
T3	7.69	7.70	2.27	2.29	2.2	2.00	29.2	29.39	10.23	10.20	320	350
T4	7.78	7.77	2.28	2.25	2.2	2.1	25.3	25.38	7.90	8.03	300	288
T5	7.78	7.77	2.28	2.24	2.1	1.91	28.4	28.36	10.17	10.10	317	320
T6	7.77	7.78	2.29	2.28	2.1	1.83	27.3	27.31	10.00	10.10	315	312
T7	7.8	7.79	2.26	2.28	2.0	1.92	22.4	22.35	7.86	8.56	280	300
T8	7.8	7.79	2.26	2.27	2.0	1.80	22.1	21.67	7.93	7.93	280	285

Conclusion

The results presented in this work showed that, the combined effect of urea and organic acid gave better results in increasing the yield of wheat especially when nitrogen fertilizers coated with humic acid and applied to the soil as it increases the yield by 2.56% and 10.21% in the first and second season, respectively relative to urea alone. The combination of N-mineral and organic acids can be considered as an integrated nutrient management to improve the soil fertility and wheat yield.

References

Abd El-Kader, N. I. K. (1998) Effect of different composted materials on some soil characteristic and biomass of barley crop under salt affected soils. *M.Sc.* Faculty of Agriculture, Tant University.

Abou El-Nour, E. A. A. (2002) Can supplemented potassium foliar feeding reduce the recommended soil potassium? *Pakistan Journal of Biological Science,* **5** (3), 259-262**.**

Ayub, G.S.E., Rocha, S.C.S. and Perrucci, A. L.I. (2001) Analysis of the surface quality of sulphur coated urea particles in a two-dimensional spoutedbed. *Braz. J. Chem. Eng.,* **vol. 18** , No.1

Bundy, L. G., Andraski, T. W. and Daniel, T. C. (1992) Placement and timing of nitrogen fertilizers for conventional and conservation tillage corn Production. *J. Prod. Agric.,* **5**, 214_221.

Cimrin, K. M. and Yilmaz, I. (2005) Humic acid applications to lettuce do not mprove yield but do improve phosphorus availability. *Acta Agr. Scand. B. Soil Plant. Sci.* **55**, 58–63.

Doberman, A. (2007) Nutrient use efficiency-measurement and management. *IFA International Workshop on Fertilizer Best Management Practices*. 7-9 March 2007, *Brussels*, Belgium.

El-Fouly, M. M. and El-Sayed, A. A. (1997) Foliar fertilization: An environmentally friendly application of fertilizers. *Dahlia Greidinger International Symposium on "Fertilization and Environment"* 24-27 March, *Haifa*, Israel, John, I. (Ed.), 346-357.

Finck, A. (1982) Fertilizers and Fertilization Introduction and Practical Guide to Crop Fertilization. *Weimheim, Deerfield Beach, Florida, Basel.* pp. **154,** 168.

Gomez, K.A. and Gomez, C.M. (1984) *Statistical Procedure for Agricultural Research.* John Wiley and Sons Inc,New Tork.

Khan, A. R. and Mir, S. (2002) Plant growth stimulation of lignite humic acid part II. Effect of lignite derived ammonium humate on wheat (*Triticum aestivum V.*) crop using different levels of phosphate fertilizer. *Pakistan J. Sci. Indust. Res.* **45**, 273-276.

Lamyaa, A. Abd EL-Rahman (2011) Response of some vegetable crops to multinutrient fertilizers under different irrigation systems**.** *PhD Thesis,* Faculty of Agricultur, Mansoura University.

Lamyaa, A. Abd EL-Rahman and Eskarous, M. A. (2014) Improving nitrogen use efficiency for wheat yield production. *J. Soil Sci. and Agric Eng.*, Mansoura Unvi., **5**(10), 1355-1361.

Malakouti, M.J. (2008) The Effect of micronutrients in ensuring efficient use of macronutrients. *Turk. J. For.,* **32**, 215-220**.**

Nardi, S., Pizzeghello, D., Muscolo, A. and Vianello, A. (2002) Physiological effects of humic substances on higher plants. *Soil Biol. Biochem.* **34**, 1527–1536.

Nasima, J., Khanif, M. Y. and Dharejo,K. A. (2010) Maize response to biodegradable polymer and urease Inhibitor coated urea. *Intl. J. Agric. Biol.* **12**, 773-776.

Nikbakht, A., Kafi, M., Babalar, M., Xia, P., Luo, A. and Etemadi, N. A. (2008) Effect of humic acid on plant growth, nutrient uptake and postharvest life of gerbera. *J. Plant Nutr.,* **31**, 2155-2163.

Omar, A.M. and Abo Bakr, M. (1995) The influence of organic matter and inorganic fertilizer on wheat crop (*Triticum aestivum* L.,) in salt affected soil. *J. A. Res., Tanta Univ.,* **21**(2), 273-283.

Page, A.L. (1982) *"Methods of Soil Analysis". Part. 2: Chemical and Microbiological Properties* (2nd ed.), Amer. Soc. Agron. Inc. Soil Sci. Soc. Amer. Inc. Madison. Wisconsin U.S.A. properties. *Agron. J*. **98**, 471-1478.

Röemheld, V. and El-Fouly, M.M. (1999) Foliar nutrient application: Challenge and limits in crop production. *Proc. 2nd International Workshop on "Foliar Fertilization"* April 4-10 Bangkok, Thailand:1-32

Sajid, A., Khan, A.R. , Mairaj, G. , Fida, M. and Bibi, S. (2008) Assessment of different crop nutrient management practices for yield improvement. *Australian J. of Crop Science,* **2** (3), 150-157.

Senesi, N. and Loffredo, E. (2005) Metal ion complexation by soil humic substances. In: Sparks, D. L. & Tabatabai, M. A. (Ed.), *Processes in Soil.* Soil Science Society of America, Madison, WI. pp. 563-618.

Sharif, M., Khattak, R. A. and Sarir, M. S. (2002) Effect of different levels of lignitic coal derived humic acid on growth of maize plants. *Commun. Soil Sci. Plant Anal.* **33**, 3567– 3580.

Shaviv, A. and Mikkelsen, R.L. (1993) Controlled-release fertilizers to increase efficiency of nutrient use and minimize environmental degradation—a review, *Fertilizer Research*, **35**, 1–12.

Tahir, M. M., Khurshid, M., Khan, M. Z., Abbasi, M. K. and Kazmi, H. (2011) Lignite-derived humic acid effect on growth of wheat plants in different soils. *Pedosphere,* **21**(1), 124-131.

Tahira, A., Saed, A., Muhammed, A., Muhammed, A. Sh., Rashed, M. B., Muhammed, A. P. and Sumira, A. (2013) Effect of humic acid application at different growth stages of kinnow mandarin (*citrus reticulate blanco*) on the basis of physio-biochemical and reproductive responses. *Academia J. of Biotechnology,* **1**(1), 014-020.

Ulukan, H. (2008) Effect of soil applied humic acid at different sowing times on some yield components in wheat (*Triticum* spp.) hybrids. *Int. J. Bot.* **4**(2), 164–175.

Verlinden, G., Pycke, B., Mertens, J., Debersaques, F., Verheyen, K., Baert, G., Bries, J. and Haesaert,G. (2009) Application of humic substances results in onsistent increases in crop yield and nutrient uptake. *J. Plant Nutr.* **32**, 1407–1426.

Zaman, M., Saggar, S., Blennerhassett, J. D. and Singh, J. (2009) Effect of urease and nitrification inhibitors on N transformation, gaseous emissions of ammonia and nitrous oxide, pasture yield and N uptake in grazed pasture system. *Soil Biol. Biochem.* **41**(6), 1270-1280.

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تأثيرخلط اليوريا بالاحماض العضويه على بعض خصائص التربه ، كفاءة استخدام السماد ، وامتصاص العناصر لمحصول القمح

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اجريت تجربه زراعيه فى محطه البحوث الزراعيه بالجميزه خلال موسمى 2012-2013 و 2013- 2014 لدراسه تأثير اضافه الاحماض العضويه (فولفيك وهيوميك) الى التربه او رش على المجموع الخضرى او تغليف اليوريا بهذه الاحماض واضافتها للتربه مقارنه باضافه اليوريا فقط على بعض خصائص التربه وامتصاصيه بعض العناصر المغذيه ومحصول القمح. حيث استخدمت ثمانيه معاملات هى 1- بدون اضافه يوريا او احماض عضويه 2- اضافه اليوريا بمعدل 75 كجم للفدان. 3- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض هيوميك تغليف. 4- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض فولفيك تغليف. 5- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض هيوميك اضافه للتربه. 6- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض فولفيك اضافه للتربه. 7- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض هيوميك رشا على المجموع الخضرى. 8- اضافه اليوريا بمعدل 75 كجم للفدان + 4 لتر حامض فولفيك رشا على المجموع الخضرى.

واوضحت النتائج ان الاضافة الاحماض العضويه ادى الى زياده الماده العضويه، النتروجين، الفوسفور والبوتاسيوم فى التربه بعد الحصاد مقارنه باضافه اليوريا فقط او الاضافه رشا على المجموع الخضرى. وكانت اعلى قيم للنتروجين الممتص للحبوب 71.76٪ والبروتين 409.05 كجم للفدان وكفاءه استخدام النتروجين 41.85 مع المعامله 3حيث اليوريا المغلفه بحامض الهيوميك وزاد محصول الحبوب بنسبه 2.56٪للموسم الاول و 10.21٪للموسم الثانى مقارنه باليوريا فقط. وتحت هذه الظروف فان فان تغليف اليوريا بالاحماض العضويه قبل اضافتها للتربه يعمل على حسن ادارتها وتقليل الفاقد منها وتحسين خصوبه التربه ويزيد من انتاجيه محصول القمح.