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Rice productivity and its inner quality as affected by anhydrous ammonia rates with foliar application of organic acids

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ABSTRACT

A field experiment was carried out at El- Gemmeiza Agricultural Research Station, El-Gharbia Governorate during the two summer growing seasons, 2011 and 2012 located at lat. 30.47, long 31.00 and 14.80 m above the mean sea level to study the effect of nitrogen fertilizer rates, i.e., control (without N fertilizer),25, 50 and 75 kg N/fed., and foliar application of humic and fulvic acids together or individually on yield, chemical composition of rice plants and nitrate as well as nitrite content in drainage water at 60 days from transplanting as well as of soil after harvesting. High level of nitrogen fertilizer (75 kg N /fed.,) achieved significantly increases of rice yield and N, P & K content of grain and straw as well as NO_2 and NO_3 of grain and straw . While, the lowest significant values of such parameters were recorded by low rates(without addition of nitrogen fertilizer)followed by 25 kg N/fed.,in both growing seasons. Foliar application of humic and fulvic acids together led to significant increases of rice yield and N, P & K content of grain and straw as well as NO_2 and NO_3 of grain and straw, whereas, the lowest significant ones were obtained when sole foliar application of fulvic acid in both seasons. In most cases, the highest significant values of rice yield and N, P & K content of grain and straw as well as NO_2 and NO_3 of grain and straw were obtained when foliar application of humic and fulvic acids together under the high levels of nitrogen fertilizer was added. While, the lowest ones were recorded with sole foliar spray of fulvic acid under the low level of N in both seasons. The high level of nitrogen fertilizer achieved significantly increases of nitrate and nitrite content in drainage water at 60 days from transplanting as well as nitrate, nitrite and ammonium of soil after harvesting compared to low rates in both seasons. While, the same parameters were increased significantly by sole application of humic and /or fulvic acidc, but the lowest ones were achieved by foliar spray of both organic acids together in both seasona. On the other hand, such parameters were significantly increased by sole foliar application of humic or fulvic acids with high levels of nitrogen fertilizer. Whereas, the lowest ones were observed by foliar spray of humic and fulvic acisd together with no addition of nitrogen fertilizer in both seasons.

Keywords: Rice plant, humic and fulvic acids, foliar spray and nitrogen fertilizer level

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INTRODUCTION

Rice is a major food crop in South America, Asia, and Africa [1]. Modern production agriculture requires efficient, sustainable, and environmentally sound management practices. Nitrogen is normally a key factor in achieving optimum lowland rice grain yields [2]. Nitrogen (N) is essential for rice, and usually it is the most yield-limiting nutrient in irrigated rice production around the world [3]. [4] and [5] reported that in cereals including rice, N accumulation is associated with dry matter production and yield of shoot and grain. [1] believed that this may be associated with maximum yield of shoot yield.

It is essential to find out the optimum rate of nitrogen application for efficient use of this element by the plants for better yield. The increasing of rice yield is mainly due to lack potential varieties and management practices. Application of fertilizer rates is of the most effective mean for maximizing yield of rice. The fact is that rice plants require more nutrients to produce more yields. Nitrogen is a major essential plant nutrient and a key input for increasing crop yield. Yield increase (70-80%) of field rice could be obtained by the application of nitrogen fertilizer [6]. Optimum dose of nitrogen fertilization plays a vital role in growth and development of rice plant. Its growth is seriously hampered when lower dose of nitrogen is applied which drastically reduces yield. Nitrogen has a positive influence on the production of effective tillers per plant, yield and yield attributes [7-8]. Nitrogen uptake during early growth stages accumulates in the vegetative growth period and is utilized for grain formation. A great portion of the N is absorbed during differentiation [9]. [10] the increase in plant height due to application of increased level of nitrogen might be associated with stimulating effect of nitrogen levels on various physiological processes including cell division and cell elongation of the plant. [11] concluded that the nitrogen application rates was affected linearly the number of grain per panicle and the grain rice yield. The yields always increase with the addition of nitrogen up to 200 kg N ha^{-1}. This implies that nitrogen is very important in the rice system, and that care should be taken to use this element at economical level.

Humic and fulvic acids are excellent foliar fertilizer carriers and activators. Application of humic or fulvic acids as foliar sprays, can improve the growth of plant foliage, roots, and yield. By increasing plant growth processes within the leaves, an increase in carbohydrates content of the leaves and stems occurs. These carbohydrates are then transported down the stems into the roots where they are in part released from the root to provide nutrients for various soil microorganisms on the rhizoplane and in the rhizosphere. The microorganisms then release acids and other organic compounds which increase the availability of plant nutrients. Other microorganisms release "hormone like" compounds which are taken up by plant roots.The role of humic and fulvic acids in overcoming the harmful effects of salinity and drought stress of plants may be due to the increase in chitinase activity [12] and stimulation plant growth through increased cell division, as well as optimized uptake of nutrients and water [13-14] also, regulate hormone level, improves plant growth and enhances stress tolerance [15]. HA is a suspension, based on potassium humates, which can be applied successfully in many areas of plant production as a plant growth stimulant or soil conditioner for enhancing natural resistance against plant diseases and pests [16]. Humic substances will maximize the efficient use of residual plant nutrients, reduce fertilizer costs, and help release those plant nutrients presently bound is minerals and salts.

Great emphasis has been placed, for the Egyptian rice production, on studies for reducing N losses andenhancing N efficiency. The objective of the present study has been to compare the effects from N-fertilizers rates as form of anhydrous ammonia and foliar application of organic acids(humic and/or fulvic) on the rice yieldquantity , qulity and NO_2& NO_3 of drainage water at 60 days from transplanting and soil after harvestingas well as NH_4 of soil .

MATERIALS AND METHODS

The field experiment was conducted at the experimental farm of Gemmeiza Agriculture Research Station (Middle Delta, Egypt), during the summer seasons of 2011 and 2012. The experimental site is located at lat. 30.47, long 31.00 and 14.80 m above the mean sea level. Physico-chemical properties of the soil were measured by the standard methods of soil chemical analysis [17]. The analysis for respective years of experimentation were presented in Table 1.

The experiment was to investigate the effect of nitrogen levels as well as humic & folvic acids individually or together on rice yield, macronutrients content of grain and straw yield , grain quality and nitrogen loss as nitrite and nitrate by leaching through drainage water as well as soil after harvesting.

A split plot design with three reiterations was used with four nitrogen levels added as a form of anhydrous ammonia (82 % N) i e., control (without N fertilizer), 25, 50 and 75 kg N/fed as main plots and organic acids (humic &fulvic acids individually or together) at rate of 5 g/L., assisted squared were allocated at random in sub-plots. fed., = faddan 4200 m^2 .

Rice seedlings varieties, Giza 104, was sown on 17^{th} and 20^{th} May at the first and second season, respectively and transplanted after 30 days from growing seed in the nursery bed in the two seasons.

Table (1): Some soil physical and chemical properties of the experimental site

Mechanical analysis		Season	
		2011	**2012**
Coarse sand	%	0.75	0.92
Sandfine		21.35	23.15
Silt		33.42	35.17
Clay		44.48	40.76
Soil texture		Clay	Clay
Chemical analysis			
pH soil: water susp., 1:2.5		7.55	7.73
EC, dSm^{-1} soil: water extract., 1:2.5		0.92	0.81
$CaCO_3$	%	3.72	3.43
OM		1.75	1.68
Ca^{++}	Meq/L	3.15	3.38
Mg^{++}		2.77	2.92
K^{+}		0.48	0.55
Na^{+}		3.49	2.69
CO_3^{--}		0.00	0.00
HCO_3^{-}		1.72	1.48
Cl^{-}		4.63	4.30
SO_4^{--}		3.54	3.76
N	Available nutrients (mg kg^{-1})	37.27	26.78
P		9.38	7.55
K		372	347

Plot size was 12.6 m^2 (3x4.2) and contained 20 rows 5 cm long and 15 cm a part. Phosphorus and potassium fertilizers were applied to all the experimental plots at rates of 15.0 kg P_2O_5 and 24 kg K_2O_5 in the form of superphosphate (15.0% P_2O_5) and potassium sulphate (48% K_2O), respectively. Both phosphorus and potassium were added during soil tillage. While, nitrogen fertilizer was injection in the soil before cultivation about 7 days. Humic and fulvic acids were divided into equal split doses to be added at basal dressing and at panicle initiation (20 and 35 days from transplanting, respectively). Both humic and fulvic acids were also added as a foliar spray on rice plant at rates of 300 L/fed. The recommended dose of zinc fertilizer was applied to nursery bed at a rate of 2kg zinc sulphate ($ZnSO_4$)/kerate (two kerate nursery transplanted on fed.). A Pisometer was established in each plot of the experiment for analyzing nitrite and nitrate in the drainage water at 60 days from transplanting as well as nitrite, nitrate and ammonium in the soil after harvisting

The net plots area were harvested and sun-dried for 5 days in the field and the total biomass yield was recorded. After threshing, cleaning and drying the grain and straw, yields were recorded. Straw yield was obtained by substracting grain yield from total biomass yield. Grains and straw samples were taken and oven dried at 70oC, crushed, digested and chemically analyzed to determine N, P and K% in grains and straw and to calculate their contents. Nitrogen was determined using micro Kjeldahl, while phosphorous was determined colorimetrically using ammonium molybdate and ammonium metavanadate according to the procedure outlined by [17]. Potassium was determined using the flame spectrophotometry method [18] and total hydrolysable carbohydrates were determined by using the method described by [19]. Nitrate and Nitrite in plant and drainage water as well as NO_2, NO_3 and NH_4 in soil after harvisting samples were determined according to the procedure outlined by [20].

The results were statistically analyzed using M stat computer package to calculate F ratio according to [21]. Least significant difference method (L.S.D) was used to differentiate means at the 0.05 level [22].

RESULTS AND DISCUSSION

Grain and straw yield as well as total carbohydrate of rice plant

Data presented in Table 2 show that the grain and straw yield wer increased significantly by using the high levels from anhydrous ammonia (75 kg N/fed.) in both seasons. Whereas, the treatment of 50 kg N/fed., gave the same trend with no significance differences between them for straw in both seasons and grain in second one.On the other hand, the lowest ones were obtained when control treatment (without nitrogen fertilizer) was applied followed by the treatment of 25 kg N/fed., in two seasons. For the total carbohydrate of grain rice plant, it was increased significantly when the control treatment was applied, while decreased significantly by increasing the anhydrous ammoni rates up to 75 kg N/fed., in the 1st season. On the contarery, this parameter wasn't affected significantly when anhydrous ammonia rates were added in the 2ndone.The increase in rice yield in response to applicationof N fertilizer is probably due to enhancing availability of nitrogen which enhanced more leaf area resulting inhigher photo assimilates and thereby resulted in more dry matter accumulation. These results are supported by the findings of [10] and **[**23**]** concluded that the grain and straw of rice yield were increased significantly by adding nitrogen fertilizer.

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With regard to the effect of foliar spray of humic and/ or fulvic individual or together ongrain and straw yield as well as total carbohydrate of grain rice plant, results reavel that, the foliar spray of humic and fulvic together increased significantly grain and straw rice yield in both seasons. On the other hand, the lowest ones were recorded when sole foliar application of fulvic acid was used in both ones.Conversely,total carbohydrate was significant increased by individual foliar spray of humic or folvic acids in the first season. While, it wasn't affected significantly when foliar spray of humic and/ or fulvic individual or together were applied in the 2ndone. The increment in growth parameter and yield may be due to that HA are extremely important component because they constitute a stable fraction of carbon, thus regulating the carbon cycle and release of nutrients, including nitrogen, phosphorus, and sulfur, which decreasing the need for inorganic fertilizer for plant growth. HA stimulates plant growth by the assimilation of major and minor elements, enzyme activation and/or inhibition, changes in membrane permeability, protein synthesis and finally the activation of biomass production [24].

Table 2 Effect of nitrogen fertilizer rates and foliar application of organic acids on yield and total carbohydrate of rice plant

Treatments	grain yield t/fed.				straw yield t/fed.				total carbohydrate (%)			
	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean
2011												
Zero nitrogen(control)	1.672	1.512	1.748	1.644	1.507	1.368	1.693	1.523	77.17	77.36	76.73	77.09
2 5 kgN/fed.	3.300	3.040	3.496	3.279	2.983	2.640	3.218	2.947	75.83	76.05	75.18	75.69
50 kg N/fed.	3.846	3.311	4.133	3.763	3.495	2.970	3.682	3.382	75.36	75.79	74.55	75.23
75 kgN/fed.	3.981	3.433	4.156	3.857	3.600	3.070	3.795	3.488	74.38	74.26	73.93	74.19
Mean	3.200	2.824	3.383		2.896	2.512	3.097		75.68	75.86	75.10	
LSD at 5%												
N- levels	0.08156				0.1094				0.5299			
Organic acids	0.09077				0.1060				0.4438			
Interaction	0.1815				0.2120				0.8877			
2012												
Zero nitrogen(control)	2.068	1.666	1.880	1.871	2.412	1.528	1.837	1.926	55.18	74.27	73.68	67.71
2 5 kg N/fed.	3.628	3.386	3.757	3.590	3.479	2.810	3.300	3.196	72.15	72.33	71.52	72.00
50 kg N/fed.	3.925	3.522	4.195	3.881	3.610	3.208	3.840	3.553	70.70	71.46	70.05	70.74
75 kg N/fed.	4.148	3.785	4.273	4.069	3.752	3.407	3.965	3.708	69.96	70.18	69.35	69.83
Mean	3.442	3.090	3.526		3.313	2.738	3.236		67.00	72.06	71.15	
LSD at 5%												
N- levels	0.2630				0.4407				NS			
Organic acids	0.2463				0.3407				NS			
Interaction	0.4926				0.6815				18.50			

Concerning the interaction effect of anhydrous ammonia rates and foliar application of organic acids on grain and straw as well as total carbohydrate of rice plant, data in Table 2 illustrate that in most cases, the highest significant values of grain and straw rice yield were obsearved when foliar spray of humic + fulvic acids together or individualy under anhydrous ammonia at the rates of 50 and 75 kg N/fed., was added in both seasons. On the other hand, the lowest ones were obtained by either humic or /andfulvic acids together or individualy with control treatment (without N fertilizer) in both ones. Vise versa, the highest significant value of carbohydrate content was recorded when humic or /and fulvic acids together or individualy with control treatment (without N fertilizer) was applied. While, the lowest one was obtained by foliar application of humic or /and folvic acids together or individualy with 75 kg N/fed.,in 1st season only. In second season, the treatment of sole foliar spray by folvic acid under control treatment (without N fertilizer) offered best significant values of carbohydrate content, while, the lowest one was recorded by sole foliar spray by humic acid with control treatment. In this conections, [25] demonstrated that the application of humic substances in combination with nitrogen fertilizer can improve the growth of plant foliage, roots, and fruits. Plant nutrients within foliar fertilizers are rapidly absorbed by the plant leaves. By increasing plant growth processes within the leaves an increase in carbohydrates content of leaves and stems occurs.

Macronutrients content of rice grain yield

Results in Table 3 obviously clear that the treatment of high level from anhydrous ammonia (75 kg N/fed.,) gave the highest significant values of N, P and K content of grain yield in both seasons. On the other hand, the lowest significant ones were obtained when control treatment (without N fertilizer) followed by the treatment of 25 kg N/fed., was applied in both ones. These results are in accordance to the findings of [26] who concluded that the improvement in yield owing to the application of N-fertilizers might be brought by the beneficial effect of these on nutrient uptake, physiological growth.

Regarding the effect of foliar spray of organic acids on N, P and K content of grain rice yield, results show that the mixture spray of humic and fulvic acids achived significant increases on such parameters, whereas, the lowest ones were recorded by sole application of fulvic acid in both seasons. A humic acid is considered to increase the permeability of plant membranes and enhance the uptake of nutrients [27 and 25]. Similarly [28] emphasize significant effect of humic acids on yield and yield components of wheat. The activation of many processes accompanied emergence of primary root and the emergence of shoot.

Concerning the effect of the interacted factors under this study, data reveal that the foliar spray by humic and fulvic acids together under the high level of anhydrous ammonia (75 kg N/fed.,) gave the highest significant values of grain macronutrients contentin both seasons. The same trend was observed by sole foliar spray of humic acid with the high level of nitrogen fertilizerin second season only. Oppositely, in most cases,the lowset significant ones wer observed when individual foliar application of humic or fulvic acids with control treatment without N fertilizer in both ones. [29] studied the effect of foliar sprays of humic acids on yield of common bean. They found that, humic acids significantly increased yield and protein contents of common bean. It can be concluded that humic substances are excellent foliar fertilizer carrier and activators. Application of humic and fulvic acids in combination with major nutrients, can improve the growth of plant. Plant nutrients within foliar fertilizers are rapidly absorbed by the plant leaves and have positive effects on physiological process into plant.

Table 3 Effect of nitrogen fertilizer rates and foliar application of organic acids on N, P and K content of rice grain yield

Treatments	N-grain(kg/fed.)				P-grain(kg/fed.)				K-grain(kg/fed.)			
	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean
2011												
Zero nitrogen(control)	20.12	18.37	21.13	19.87	5.580	5.790	5.940	5.770	22.56	21.77	26.18	23.50
2 5 kgN/fed.	41.36	39.52	45.68	42.19	11.66	10.58	13.16	11.80	53.37	49.56	56.28	53.07
50 kg N/fed.	52.53	45.67	56.48	51.56	13.42	11.97	15.15	13.51	61.44	56.55	68.27	62.09
75 kgN/fed.	57.38	53.22	58.95	56.52	14.22	13.08	16.71	14.67	70.50	61.92	72.28	68.23
Mean	42.85	39.19	45.56		11.22	10.35	12.74		51.97	47.45	55.75	
LSD at 5%												
N- levels	0.4728				0.2095				0.3929			
Organic acids	0.4979				0.3035				0.6193			
Interaction	0.9958				0.6070				1.239			
2012												
Zero nitrogen(control)	17.60	20.55	23.20	20.45	5.047	6.150	6.670	5.956	28.87	24.65	28.73	27.42
2 5 kg N/fed.	47.41	43.72	49.36	46.83	13.48	11.52	13.87	12.96	57.75	53.48	60.22	57.15
50 kg N/fed.	54.23	48.10	57.71	53.35	15.53	13.41	16.88	15.27	66.31	59.47	71.60	65.79
75 kg N/fed.	60.90	55.15	61.50	59.18	16.97	15.50	17.73	16.73	72.41	65.50	75.69	71.20
Mean	45.03	41.88	47.94		12.76	11.65	13.79		56.34	50.78	59.06	
LSD at 5%												
N- levels	2.015				0.8398				2.077			
Organic acids	1.498				0.5328				1.848			
Interaction	2.995				1.066				3.697			

Macronutrients content of rice straw yield

Generally, the same trend of grain macronutrients content were observed for such parameters of rice straw . data tabulated in Table 4 reveal that the N, P and K content of straw were increased significantly by increasing anhydrous ammonia rates up to 75 kg N/fed., while , the same parameters were decreased significantly when control treatment (without N fertilizer) followed by 25 kg N/fed., was applied in both seasons. The present resultsexplicitly confirm the similar results obtained by [30] who stated that the demand of the rice plant for other macronutrients mainlydepends on the N supply. In the same way, higher plantmacronutrient accumulation was observed in higher N level .

With respect to the effect of organic acids as foliar application on N, P and K content of straw; results show that the foliar application of humic and fulvic acids together led to highest significant values of all parameters in Table 4. While, the lowest ones were obtained by foliar applicaton of fulvic acid individually in both seasons. This may be explained as due to the application of humic and fulvic acids as a spraying on plants increasing the roots of plants and increasing the surface area for roots per unit length.This greatly enhances exudation of carboxylates, phenolics water, solubilization of mineral and organic nutrients and consequently uptake of inorganic nutrients, amino acids and water per unit root mass. This was reflected on increasing the movement of nutrients through plant parts. This result agrees with [31-32] who reported that the beneficial effect of humic acids on plant growth is related to its role as it acts like plant growth hormones.

Table 4 Effect of nitrogen fertilizer rates and foliar application of organic acids on N, P and K content of rice straw yield

Treatments	n-straw(kg/fed.)				p-straw(kg/fed.)				k-straw(kg/fed.)			
	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean
2011												
Zero nitrogen(control)	9.73	9.15	10.68	9.853	3.250	2.700	3.650	3.200	10.17	9.583	10.87	10.21
2 5 kgN/fed.	21.30	19.00	21.55	20.62	6.140	5.800	6.730	6.223	23.81	22.00	26.08	23.96
50 kg N/fed.	23.98	22.50	25.74	24.06	7.240	6.550	8.740	7.510	27.10	24.95	30.36	27.47
75 kgN/fed.	27.42	24.10	30.00	27.17	8.330	7.510	9.830	8.557	31.28	29.63	35.57	32.16
Mean	20.60	18.69	21.99		6.240	5.640	7.237		23.09	21.54	25.72	
LSD at 5%												
N- levels	0.4643				0.3422				0.3008			
Organic acids	0.3429				0.2030				0.3631			
Interaction	0.6858				0.4059				0.7262			
2012												
Zero nitrogen(control)	10.18	9.430	11.07	10.23	3.267	3.080	3.790	3.379	17.24	9.620	11.22	12.69
2 5 kg N/fed.	22.22	19.60	23.20	21.67	7.050	6.780	7.660	7.163	25.38	22.99	26.74	25.04
50 kg N/fed.	25.15	24.00	26.88	25.34	8.730	7.580	9.320	8.543	28.96	26.10	31.84	28.97
75 kg N/fed.	28.64	24.57	31.84	28.35	9.420	8.570	10.51	9.499	33.87	30.53	36.41	33.60
Mean	21.55	19.40	23.25		7.117	6.503	7.819		26.36	22.31	26.55	
LSD at 5%												
N- levels	0.1711				0.3052				3.849			
Organic acids	0.3144				0.2240				3.036			
Interaction	0.6289				0.4480				6.073			

For the effect of interacted factours under study, data reveal that the highest significant values of all parameters were observed when foliar spray of humic and fulvic acids together under 75 kg N/fed., was practeced. On the other hand, the lowest significant ones were recorded by sole application of humic or fulvic acids with control treatment(without N fertilizer) in both seasons.These results are supported by the findings of [27 and 25].

Table 5 Effect of nitrogen fertilizer rates and foliar application of organic acids on NO_2 and NO_3(ppm) content of rice grain and straw yield

Treatments	No_2 - straw				No_3 -straw				No_2 -grain				No_3 -grain			
	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean	humic	fulvic	H +F	Mean
2011																
Zero nitrogen (control)	1.437	1.310	1.680	1.476	3.960	3.180	4.270	3.803	0.9800	0.840	1.153	0.991	1.330	1.200	1.730	1.420
2 5 kgN/fed.	3.050	2.620	3.580	3.083	5.820	4.940	6.170	5.643	1.210	1.050	1.760	1.340	1.970	1.520	2.270	1.920
50 kg N/fed.	4.930	3.800	5.260	4.663	6.220	5.530	6.780	6.177	1.930	1.480	2.150	1.853	2.610	2.080	2.960	2.550
75 kgN/fed.	5.380	4.270	6.330	5.327	6.730	5.980	6.960	6.557	2.550	1.920	2.880	2.450	3.410	2.780	3.950	3.380
Mean	3.699	3.000	4.213		5.682	4.908	6.045		1.668	1.322	1.986		2.330	1.895	2.727	
LSD at 5%																
N- levels	0.2364				0.3755				0.4175				0.2474			
Organic acids	0.2433				0.3060				0.3515				0.2508			
Interaction	0.4865				0.6120				0.7031				0.5017			
2012																
Zero nitrogen (control)	2.063	1.730	1.893	1.896	4.150	3.470	4.680	4.100	1.050	0.800	1.350	1.067	1.753	1.250	1.950	1.651
2 5 kg N/fed.	3.270	2.880	3.950	3.367	6.790	5.950	7.220	6.653	1.420	1.310	1.930	1.553	2.280	1.980	2.600	2.287
50 kg N/fed.	5.280	4.920	5.880	5.360	7.250	6.713	7.697	7.220	2.260	1.970	2.550	2.260	2.930	2.700	3.220	2.950
75 kg N/fed.	5.920	4.790	6.520	5.743	7.710	7.100	7.980	7.597	2.910	2.600	3.157	2.889	3.820	3.400	4.330	3.850
Mean	4.133	3.580	4.561		6.475	5.808	6.894		1.910	1.670	2.247		2.696	2.332	3.025	
LSD at 5%																
N- levels	0.3611				0.3755				0.1749				0.2778			
Organic acids	0.3483				0.2338				0.2417				0.3662			
Interaction	0.6967				0.4677				0.4834				0.7323			

NO_2 and NO_3 content of rice grain and straw yield

Results in Table 5 reveal that the same trend of abovementioned results are presented in this Table, the threatment of 75 kg N/fed., (high level of anhydrous ammonia) gave the highest significant values of NO_2 and NO_3 content of rice grain and straw yield. On the other hand, the lowest ones were obtained by control treatment follwed by 25 kg N/fed., in both seasons. Nitrates absorbed by plant roots are normally incorporated into plant tissue as amino acids, proteins, and other nitrogenous compounds. Thus, the concentration of nitrate in the plant is usually low. The primary site for converting nitrates to these products is in growing green leaves. Under unfavorable growing conditions, especially drought, this conversion process is retarded, causing the nitrate to accumulate in the stalks, stems, and other conductive tissue. In this respect, [30] found that the values of NO_2 and NO_3 in rice grain were increased significantly with increasing nitrogen fertilizer rates.

With respect to the effect of foliar spray with organic acids on NO_2 and NO_3content of rice grain and straw yield, foliar application of humic and fulvic acids together was increased significantly all such parameters. While, the lowest ones were obtained when foliar application of fulvic acid alone was applied in both seasons.

For the effect of interacted factors under study, NO_2 and NO_3 content of rice grain and straw yield were increased significantly when foliar spray of mixture humic and fulvic acids with high level of anhydrous ammonia 75 kg N/fed., in both seasons. Whereas, foliar application of humic acid alone under the same level of N fertilizer gave the same significant values of NO_2 and NO_3 content of rice grain and straw yield in second one only. Vis versa, the lowest significant values of such parameters were obtained by sole foliar application of fulvic acid under control treatment(without N fertilizer) in both seasons.

NO_2 and NO_3 content of diranage water at 60 days afetr transplanting as well as of soil after harvesting rice

Data tabulated in Tables 6&7 show that the highest significant values of all parameters in this Tabels 6 &7 were observed by adding high level of nitrogen fertilizer. Whereas, such parameters were decreased significantly when control treatment follwed by 25 kg N/fed., were practised in both seasons. In this connection, [33] settled that the diranage water is that portion of water underneath the surface of the soil that can be collected with boreholes, tunnels, or drainage galleries, or that flows naturally to the soil's surface via seeps or springs. Also, [34] observed that high rates of N fertilizer used in the production of continuous corn have resulted in excessive nitrate- N leaching in groundwater which frequently exceeded the maximum contamination level of 10 mg L^{-1}. Furthermore, [35-36] stated that in aerobic condition, NH_4^+ may be transformed to nitrate (NO_3^-) via nitrification . Since groundwater is an indispensable water resource for human consumption especially in developing countries and the fact that eventually contaminants in the groundwater will be discharged into the river or streams which is also a source of drinking water, most authors referred to the drinking water standard guidelines as a baseline to assess the contamination level.

Regarding the effect of foliar application by organic acids on parameters in Tables 6 &7, in most cases, data illustrate that the lowest significant values were recorded when foliar application of humic and fulvic together in both seasons. Conversely, the highest ones were obtained by adding foliar spray of humic or fulvic acids individually in both seasons. On the other hand, NO_2 and NH_4 of soil after harvesting were not affected by foliar application of organic acids in second season only.Similar results were obtained by [37] who concluded that the organic manure application with chemical fertilizers increased the yield and nitrogen use efficiency of rice, reduced the risk of environmental pollution and improved soil fertility greatly. It could be a good practical technique that protects the environment and raises the rice yield in this region.

Table 6 Effect of nitrogen fertilizer rates and foliar application of organic acids on NO_2 and NO_3(ppm) content of diranage water at 60days afetr transplanting

Treatments	NO_2 in diranage water				NO_3 in diranage water			
	humic	folvic	H +F	Mean	humic	folvic	H +F	Mean
2011								
Zero nitrogen(control)	2.000	2.020	2.000	2.007	4.620	4.680	4.450	4.583
2 5 kgN/fed.	5.480	5.580	5.100	5.387	6.720	6.770	6.050	6.513
50 kg N/fed.	5.420	5.650	5.250	5.440	6.660	6.900	6.440	6.667
75 kgN/fed.	5.700	5.920	5.250	5.623	8.000	8.350	7.100	7.817
Mean	4.650	4.793	4.400		6.500	6.675	6.010	
LSD at 5%								
N- levels	0.2219				0.2849			
Organic acids	0.3329				0.2257			
Interaction	0.6659				0.4514			
2012								
Zero nitrogen(control)	2.787	2.250	1.960	2.332	3.730	4.840	4.580	4.383
2 5 kg N/fed.	5.600	5.730	5.870	5.733	7.360	7.810	7.550	7.573
50 kg N/fed.	5.980	6.220	5.850	6.017	7.150	7.850	6.930	7.310
75 kg N/fed.	6.730	7.000	5.930	6.553	8.550	9.100	8.060	8.570
Mean	5.274	5.300	4.903		6.698	7.400	6.780	
LSD at 5%								
N- levels	0.5348				0.5133			
Organic acids	0.3672				0.5615			
Interaction	0.7344				1.123			

Table 7 Effect of nitrogen fertilizer rates and foliar application of organic acids on NO_2, NO_3 and NH_4(ppm) content of soil after harvesting rice

Treatments	NO_2 - soil				NO_3 - soil				NH_4 soil			
	humic	folvic	H +F	Mean	humic	folvic	H +F	Mean	humic	folvic	H +F	Mean
2011												
Zero nitrogen(control)	1.180	1.240	1.050	1.157	3.250	3.280	3.110	3.213	9.650	9.730	9.250	9.543
2 5 kgN/fed.	1.580	1.720	1.380	1.560	3.753	4.250	3.750	3.918	11.70	11.96	11.42	11.69
50 kg N/fed.	2.410	2.580	2.220	2.403	5.000	5.170	4.550	4.907	12.42	12.85	11.80	12.36
75 kgN/fed.	2.980	3.100	2.870	2.983	5.650	5.880	5.150	5.560	13.70	14.10	12.85	13.55
Mean	2.037	2.160	1.880		4.413	4.645	4.140		11.87	12.16	11.33	
LSD at 5%												
N- levels	0.2501				0.4392				0.3574			
Organic acids	0.2791				0.2831				0.3832			
Interaction	0.5582				0.5662				0.7663			
2012												
Zero nitrogen(control)	1.687	1.100	0.950	1.246	3.000	3.130	2.900	3.010	7.074	9.820	9.400	8.765
2 5 kg N/fed.	1.300	1.670	1.150	1.373	3.510	4.080	3.280	3.623	11.47	11.71	11.10	11.43
50 kg N/fed.	2.230	2.370	2.100	2.233	4.660	5.080	4.270	4.670	12.23	12.30	11.00	11.84
75 kg N/fed.	2.660	2.890	2.500	2.683	5.100	5.550	4.870	5.173	13.22	13.87	12.53	13.21
Mean	1.969	2.007	1.675		4.068	4.460	3.830		11.00	11.92	11.01	
LSD at 5%												
N- levels	0.2754				0.3555				1.526			
Organic acids	NS				0.2750				NS			
Interaction	0.7220				0.5501				2.413			

Concerning the interacted factors under study on all parameters in Tables 6 & 7, results show that such parameters were increased significantly when sole foliar application of humic or fulvic acids with high level of nitrogen fertilizer. On the other hand, the lowest ones were observed by foliar application of humic or fulvic acids together or individually with control treatment (without N fertilizer) in both seasons.

Such improvement in yield and chemical parameters, especially in a crop like rice in Egypt, is seriously needed since all parts of rice plants are hundred percent in use regardless fresh or dry. Moreover, best nitrogen fertilizer rates as well as humic and fulvic acids are natural components. Consequently, they are harmless for use from an environmental point of view.

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