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EFFECT OF NITROGEN FERTILIZATION, HUMIC ACID AND COMPOST EXTRACT ON YIELD AND QUALITY OF RICE PLANTS

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ABSTRACT

Two field experiments were carried out at El- Gemmeiza Agricultural Research Station, El-Gharbia Governorate during the two summer growing seasons, 2007 and 2008 to study the effect of nitrogen fertilizer rates, i.e., 15, 30 and 45 kg N/fed and foliar application of compost extract & humic acid on yield components, yield and chemical composition of rice plants and nitrate as well as nitrite content in drainage water at different stages from transplanting.

Results can be summarized as follows:-

Generally, high level of nitrogen fertilizer achieved significantly increases of rice yield and its components as well as N, p & K content of grain and straw compared with low rates in both growing seasons. While, in most cases, the same trend was recorded when second level of 30kg N/fed was practiced.

Spraying humic acid or compost extract led to significant increases in most parameters of yield and its components as well as N, p & K content of grains and straw compared to no addition of such organic compounds in both seasons.

In most cases, the interaction effect between the factors under study was insignificant on rice yield and its components as well as macronutrients content of grains and straw in both seasons.

The high level of nitrogen fertilizer achieved significantly increases of nitrate and nitrite content in drainage water at different stages from transplanting compared to low rates in both stages of two growing seasons. On the other hand, such parameters weren't significant affected by foliar application of humic acid, compost extracts or the interaction between them and nitrogen levels in both seasons.

Keywords: Rice plant, compost extract, humic acid, nitrogen fertilizer level

INTRODUCTION

Rice is one of the most important cereal crops in the world, both for local consumption and export. Recently, its productivity in Egypt has scored the highest level all over the world being about' 10 ton/ha. The growth of rice was found to be affected by nitrogen under Egyptian soil conditions. Fischer (1998) concluded that rice production must be increased by about 65% more than today to meet the demand projected for 2025. If the technologies that affect nutrient utilization by the rice crop remain unchanged, that production increase will require almost 300% more than the present application rate of N alone in irrigated environments. This is an undesirable amount economically and environmentally. The nutrient-use efficiency of rice cropping systems must be improved, along with yield potential of rice cultivars, in order to improve profitability of rice production and prevent environmental degradation in irrigated areas.

Nitrogen is one of the most yield-limiting nutrients in lowland rice production, and proper N management is essential for optimizing rice grain yields (Fageria *et al.*, 1997). However, N fertilizer is one of the most expensive inputs for rice production and N deficiencies are widely reported in lowland rice soils (Fageria and Baligar, 1996 and Kundu *et al.*, 1996). Nitrogen recovery efficiency for lowland rice grown in the tropics is typically 30 to 50% of applied N (Fageria and Baligar, 2001). Furthermore, the N fertilizer rate that produced maximum grain yield also produced the highest head rice (whole milled rice) yield (Bond and Bollich, 2007). Nitrogen rates for optimum grain yield vary based on cultivar and soil texture (Bond *et al.*, 2006; Norman *et al.*, 2005 and Walker, 2006). Rice grown on clay soils typically requires more fertilizer N, even though native soil N concentrations are greater on clay soils.

Organic materials such as farmyard manure can be considered as a humus supplying and a soil improving agents. Enhancement of plant growth using humic acid had been reported to be due to increasing nutrients uptake such as N, Ca, P, K, Mg, Fe, Zn and Cu and binding toxic elements such as Al (Adani *et al.*, 1998). Enhancement of photosynthesis, chlorophyll density and plant root respiration has resulted in greater plant growth with humate application (Tan and Binger, 1986). Natural products which contain phytohormones or exhibit hormone-like activity, have received increasing attention for use as nutrient supplements in agriculture and horticulture. Humic acids are in common use as major components in biostimulant formulations (Zhang and Schmidt, 1999). Vaughan *et al.* (1985) found that Grow-Plex SP is a water soluble source of humic acid. It also supplies high levels of soluble potassium and phosphorus in readily available forms. Combined with humic acid, potassium, phosphorus, calcium, iron and sulfur can be rapidly absorbed and incorporated into plant whether via soil or foliar application methods. Adani *et al.* (2006) concluded that the all humic substances are composed of chemically complex, non-biochemical organic components, which are largely hydrophilic, amorphous, dark colored, liquid, or powder and resistant to chemical and biological degradation. Also, they added that possible mechanisms involved in the stimulation of plant growth include the assimilation of major and minor elements, biochemical effects (enzyme activation and/ or inhibition, changes in membrane permeability, protein synthesis). Osman *et al.* (2009) concluded that possibility of soaking of compost (Tea compost) to in injection with drip irrigation or foliar application to improve the efficiency of fertilization and decreased the hazard of chemical fertilizers.

The aim of the present work is to study the effects of nitrogen fertilizer rates and humic acid & compost extract as a foliar spray on rice yield and its components as well as macronutrients uptake.

MATERIALS AND METHODS

The present study was carried out during two successive summer seasons of 2007 and 2008 at the experimental farm of Gemmeiza Agriculture Research Station (Middle Delta, Egypt).

Soil of the experimental site is clay loam in texture; physical and chemical properties were determined according to Ryan *et al.*, (1996) and recorded in Table (1a). The compost used is made from plant residues that were composted for three months till ripening. The ripening compost was then soaked in enough water for 48 h to obtain compost extract. The chemical analysis of compost is shown in Table (1b), while chemical composition of humic acid is shown in Table (1c).

The experiment was to investigate the effect of nitrogen levels and humic acid & compost extract on vegetative growth characters, yield component, grain quality and nitrogen loss as nitrite and nitrate by leaching through drainage water.

A split plot design with four replicates was used with three nitrogen levels 15, 30 and 45 kg N/fed as main plots and humic acid at rate of 6 g/L., compost extract at a rate of 10%, and non nutrient treatment served check were allocated at random in sub-plots.

Rice seedlings was sown on 13th and 18th 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 (1a): Some soil physical and chemical properties of the experimental site

Mechanical analysis		Season	
		2007	2008
Coarse sand	%	0.71	0.95
fine Sand		24.65	21.95
Silt		25.58	30.88
Clay		49.06	46.22
Soil texture		Clay	Clay
Chemical analysis			
pH soil: water susp., 1:2.5		7.4	7.6
EC, dSm^{-1} soil: water extract., 1:2.5		0.87	0.73
$CaCO_3$	%	4.84	4.15
OM		1.86	1.68
Ca^{++}	Meq/L	2.98	2.00
Mg^{++}		2.26	2.13
K^{+}		0.54	0.48
Na^{+}		2.90	2.70
CO_3^{--}		0.00	0.00
HCO_3^{-}		1.60	1.30
Cl^{-}		3.60	3.00
SO_4^{--}		3.48	3.01
N	Available nutrients (mg kg^{-1})	34.6	28.8
P		9.75	12.25
K		340	360

Plot size was 12 m^2 (3x4) and contained 20 rows 5 cm long and 15 cm a part. Phosphorus and potassium fertilizers were applied at rates of 15.5 kg P_2O_5 and 24 kg K_2O_5 in the form of superphosphate (15.5% P_2O_5) and potassium sulphate (48% K_2O), respectively. Both phosphorus and potassium were added during soil tillage. While, nitrogen, humic acid and compost extract 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 acid and compost extract 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 35 and 50 days from transplanting

Table (1b): Main characters of the humic acid used (Liquid organic fertilizer)

properties	E.C dSm^{-1} (1:10)	pH (1:10)	available macronutrients %				available micronutrients (mgL^{-1})					O C	C/N
			N	P	K	Mg	Fe	Mn	Zn	Cu	B	%	ratio
Values	5.91	8.18	10	10	10	0.05	900	90	90	90	70	24.64	2.46

Table (1c): Main characters of the *extract compost used

properties	E.C	pH	Total %			O C	O M	C/N
	dsm^{-1}		N	P	K	%		ratio
2007	1.11	7.55	2.01	0.72	0.72	20.41	35.20	10.15
2008	1.21	7.82	1.94	0.75	0.68	24.19	41.70	12.50

***Extract ratio= 1: 10 (compost: water)**

At harvest time, the following parameters were recorded: plant height, numbers of tillers/m^2, number of panicle/m^2, panicle length, number of filled grains/pancil, 1000-grain weight, grain and straw yields. Grains and straw samples were taken and oven dried at 70°C, 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 Ryan *et al.* (1996). Potassium was determined using the flame spectrophotometry method (Black, 1982) and total hydrolysable carbohydrates were determined by using the method described by Megnetski *et al.* (1959). Nitrate and Nitrite in plant and drainage water samples were determined according to the procedure outlined by Singh (1988).

The results were statistically analyzed using M stat computer package to calculate F ratio according to Gomez and Gomez (1984). Least significant difference method (L.S.D) was used to differentiate means at the 0.05 level (Waller and Duncan, 1969).

RESULTS AND DISCUSSION

1. Yield components of rice plants:

Data presented in Table (2) show the influence of nitrogen fertilizer rates on some yield components of rice plants grown in the successive seasons of 2007 and 2008. Results reveal that there were significant increases in all parameters in both seasons when nitrogen fertilizer was added at the high level (45 kg N/fed) except for, plant height in the first season only which wasn't affected by nitrogen fertilizer rates. Meanwhile, the same trend was recorded when second level 30kg N/fed was added for Panicle length and No. of filled grains /panicle in both seasons as well as No. of tillers/m^2 in the first season only and plant height in the second one. On the other hand, the lower significant values of all parameters were observed when 15 kg N/fed was applied in both seasons. These results confirmed those obtained by Norman *et al.* (2005), Walker (2006), Bond *et al.* (2006) and Bond & Bollich (2007) Also, Reay-Jones *et al.* (2008) stated that increasing nitrogen rate from 67 to 134 kg N /ha increased significantly yield of rice plant by 591 kg per ha.

Concerning the effect of organic acids on yield components of rice plants, data reveal that the all parameters in Table (2) were affected significantly by foliar application of humic acid on rice plant compared with control treatment (without addition of organic compounds) in both seasons with one exception of plant height in the second season only which wasn't affected by such treatments. Also, data show that foliar application of compost extract on rice plant gave a similar significant effect of sprayed humic acid on panicle length and No. of filled grains /panicle in both seasons, while plant height in first season only didn't appear significant response. These results agree with those obtained by Akanbi *et al.* (2007) who affirmed that the possibility of solving the transportation and application problems associated with the adoption of compost technology was explored by applying the manure extract from cassava peel and tithonia plant composts in form of foliar spray or liquid fertilizer as nutrient source. Also, Ulukan (2007) concluded that the humic acid enhances plant growth both directly and indirectly and they have yield increases effect at different values and different crops.

Data tabulated in Table (2) reveal that there weren't significant differences between the interacted nitrogen fertilizer rates and foliar application of humic acid, compost extract and without addition of such compounds on all yield components of rice plants in first season. On the other hand, foliar application of humic acid under upper nitrogen level gave the highest significant values of No. of tillers/m^2, number of panicle/m^2 and panicle length while, the lowest ones were recorded when no addition of organic compounds with 15 kg N/ fed was applied in second season only. In this connection, Sary *et al.* (2009) concluded that increasing wheat yield by combined effect of bio-organic and chemical fertilizers is promising goals in wheat production for decreasing high doses of chemical fertilizer, also, get cleaner product with low undesirable high doses of heavy metals and other pollutants.

Table (2): Effect of N rates and organic compounds on yield components of rice plants

Treatments		2007 Season					2008 Season				
N rates	organic compounds	Plant height	No. of tillers/m^2	No. of panicle /m^2	Panicle length (cm)	No. of filled grains /panicle	Plant height	No. of panicle /m^2	No. of Panicle/m^2	Panicle length (cm)	No. of Filled grains /panicle
15 kg N/fed.	Without	87.30	375.0	349.0	16.00	108.0	90.10	386.0	355.0	16.40	115.0
	*CE	90.70	450.0	432.0	19.20	119.0	93.28	458.0	446.0	19.60	124.0
	**H A	91.80	500.0	485.0	20.80	124.0	95.50	517.0	509.0	21.20	131.0
Mains (Average N)		89.93	441.7	422.0	18.67	117.0	92.96	453.7	436.7	19.07	123.3
30 kg N/fed.	Without	89.60	450.0	432.0	18.20	114.0	93.13	458.0	445.0	18.60	123.0
	CE	93.50	500.0	486.0	20.80	131.0	97.25	512.0	503.0	20.80	138.0
	H A	94.90	525.0	515.0	21.80	141.0	97.32	515.3	530.0	22.20	143.0
Mains (Average N)		92.67	491.7	477.7	20.27	128.7	95.90	495.1	492.7	20.53	134.7
45 kg N/fed.	Without	90.20	475.0	462.0	21.00	118.0	95.20	483.0	473.0	21.40	131.0
	CE	93.40	510.0	491.0	21.40	136.0	99.25	522.0	514.0	21.20	145.0
	H A	95.60	550.0	543.0	22.60	146.0	101.3	567.0	562.0	23.20	150.0
Mains (Average N)		93.07	511.7	498.7	21.67	133.3	98.58	524.0	516.3	21.93	142.0
Over all mean for sub plot	Without	89.03	433.3	414.3	18.40	113.3	92.81	442.3	424.3	18.80	123.0
	CE	92.53	486.7	469.7	20.47	128.7	96.59	497.3	487.7	20.53	135.7
	H A	94.10	525.0	514.3	21.73	137.0	98.04	533.1	533.7	22.20	141.3
LSD											
N		NS	19.0	31.4	1.95	5.8	4.97	21.1	13.7	2.35	12.0
Organic compounds		3.76	38.0	38.9	2.39	9.2	NS	30.6	12.2	2.09	11.5
Interaction		NS	NS	NS	NS	NS	NS	34.2	13.6	2.34	NS

*C E= Compost extract.

**H A= Humic acid.

2. Filled grains weight/panicle, 1000 - grain weight as well as grains and straw yields:

Results in Table (3) illustrate that the treatment of 45 kg N/fed achieved the highest values of filled grains weight/panicle, 1000 - grain weight as well as grain and straw yield compared with low level of nitrogen fertilizer (15 kg N/fed) in both seasons. Meanwhile, no significant differences could be observed between second and third levels of nitrogen fertilizer on filled grains weight/panicle, 1000 - grain weight and straw yield in first season as well as grain and straw yield in second season. These results confirmed those obtained by Reay-Jones *et al.* (2008) who found that reducing nitrogen rate below the recommended rate significantly ($P<0.05$) reduced rice yield, indicating the value of providing the rice plant with sufficient levels of nitrogen. Regarding the effect of organic compounds, data available in Table (3) show that foliar application of humic acid increased significantly filled grains weight/panicle and grain yield in first season, while in the second one, foliar spray of humic acid or compost extract gave a similar significant increase of filled grains weight/panicle, 1000 - grain weight and grain yield. On the other hand, the lowest values of the same parameters were obtained with no addition of such organic compounds in both seasons. Also, data reveal that 1000 - grain weight in first season as well as straw yield in both seasons weren't significantly affected by foliar application of organic acid. Similar finding was achieved by Zhang and Ervin (2004) who reported that humic acid contains cytokinins and their application resulted in increased endogenous cytokinin and auxin levels which possibly leading to improve yield. This may explain the increment in the filled grains weight/panicle and grain yield observed in this study. In addition, Siddiqui *et al.* (2008) suggested that use of *Trichoderma*-enriched compost extracts would be more beneficial in environmentally friendly okra cultivation and may be used as an alternative to inorganic fertilizers/fungicides to enhance plant growth and reduce disease incidence subsequently, resulting in higher yield.

Data in Table (3) reveal that there weren't significant differences between the interacted factors on filled grains weight/panicle, 1000 - grain weight as well as grain and straw yield in both seasons.

3. Macronutrients content of rice grain and straw:

Available data in Table (4) show clearly that the application of nitrogen fertilizer at 45 kg N/fed gave the highest significant values of N, P and K content of grain and straw in both seasons, with one exception in second season, where N content of straw wasn't affected by nitrogen fertilizer level. Whereas, the second rate of nitrogen fertilizer gave a similar significant increase of N and P content of grain & straw as well as K content of straw in first season, while, P content of grain and K content of straw were significantly highest in the second season. Conversely, the lower level of nitrogen fertilizer achieved a significant decrease in the same parameter in both seasons. Similar results were obtained by Mahdi- Iqbal *et al.* (1992) concluded that the uptake of NPK was increased with increasing rates of N. Maximum uptake of NPK were recorded in the treatment receiving 90 kg N ha-1. The minimum NPK uptake in rice plant was obtained in the control treatment.

Table (3): Effect of N rates and organic compounds on Filled grains weight/panicle, 1000 - grain weight as well as grains and straw yields

Treatments		2007 Season				2008 Season			
N rates	organic compounds	Filled grains weight/ panicle (g)	1000 - grain weight (g)	Grain yield (ton/fed.)	Straw yield (ton/fed.)	Filled grains weight/ panicle (g)	1000 - grain weight (g)	Grain yield (ton/fed.)	Straw yield (ton/fed.)
15 kg N/fed.	Without	2.72	24.30	2.93	2.82	2.93	25.40	2,98	2.89
	C E	3.27	26.70	3.63	2.83	3.42	27.47	3.67	2.91
	H A	3.46	27.10	3.84	2.97	3.72	28.44	3.94	3.07
Mains (Average N)		3.15	26.03	3.47	2.87	3.36	27.10	3.53	2.96
30 kg N/fed.	Without	2.96	25.10	3.27	3.32	3.21	26.13	3.32	3.41
	C E	3.66	27.18	3.82	3.55	3.89	28.24	3.88	3.70
	H A	3.98	27.67	4.08	3.70	4.09	28.65	4.14	3.86
Mains (Average N)		3.53	26.65	3.72	3.52	3.73	27.67	3.78	3.65
45 kg N/fed.	Without	3.26	26.80	3.53	3.66	3.65	27.80	3.61	3.84
	C E	3.83	27.45	3.96	3.73	4.13	28.52	4.20	3.97
	H A	4.18	27.98	4.26	3.81	4.34	28.97	4.33	4.07
Mains (Average N)		3.76	27.41	3.92	3.73	4.04	28.43	3.99	3.96
Over all mean for sub plot	Without	2.98	25.40	3.24	3.27	3.26	26.44	3.30	3.38
	C E	3.59	27.11	3.80	3.37	3.81	28.08	3.86	3.52
	H A	3.87	27.58	4.06	3.49	4.05	28.69	4.14	3.66
LSD									
N		0.23	1.26	0.12	0.30	0.28	0.73	0.31	0.36
Organic compounds		0.18	NS	0.19	NS	0.29	1.56	0.29	NS
Interaction		NS	NS	NS	NS	NS	NS	NS	NS

Table (4): Effect of N rates and organic compounds on nutrients content of grain and straw (kg/fed)

Treatments		2007 Season						2008 Season					
		grains			straw			Grains			Straw		
N rates	organic compounds	N	P	K	N	P	K	N	P	K	N	P	K
15 kgN/fed.	Without	40.12	9.67	55.08	11.33	4.38	26.53	41.72	10.43	56.62	12.14	5.02	28.51
	C E	51.62	13.00	69.67	15.00	5.38	30.56	41.08	13.58	72.29	16.59	6.40	32.30
	H A	55.68	14.59	77.18	17. 27	6.54	32.99	58.78	15.76	81.16	18.07	7.35	35.21
Mains (Average N)		49.14	12.42	67.31	14.53	5.43	30.03	47.19	13.26	70.02	15.60	6.26	32.01
30 kgN/fed.	Without	46.11	11.44	62.46	15.98	6.33	35.63	47.47	12.28	63.41	16.71	7.50	38.53
	C E	56.15	14.90	76.02	20.57	7.80	39.00	55.17	15.90	78.76	22.15	9.23	42.46
	H A	60.79	16.73	84.05	22.60	9.63	42.24	62.93	17.39	86.52	24.27	10.41	45.85
Mains (Average N)		54.35	14.36	74.18	19.72	7.92	38.96	55.19	15.19	76.23	21.04	9.04	42.28
45 kgN/fed.	Without	50.83	13.41	69.19	18.48	8.43	40.30	53.07	14.17	71.84	19.97	9.22	44.56
	C E	59.40	15.84	81.97	23.13	8.95	41.78	61.51	17.29	84.42	24.98	10.31	47.18
	H A	64.75	18.32	90.31	24.42	10.05	44.25	67.55	19.05	93.53	26.86	11.80	50.88
Mains (Average N)		58.33	15.86	80.49	22.01	9.14	42.11	60.71	16.84	83.26	23.94	10.44	47.54
Over all mean for sub plot	Without	45.69	11.51	62.24	15.26	6.38	34.15	47.42	12.29	63.96	16.27	7.25	37.20
	C E	55.72	14.58	75.89	19.57	7.38	37.11	52.58	15.59	78.49	21.24	8.65	40.65
	H A	60.41	16.55	83.85	21.43	8.74	39.83	63.09	17.40	87.07	23.07	9.85	43.98
LSD													
N		4.42	3.41	1.16	2.32	2.19	3.93	NS	2.09	2.63	2.65	0.85	6.66
Organic compounds		3.71	2.53	2.62	2.35	1.66	NS	14.64	1.85	2.54	3.71	2.13	NS
Interaction		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

With respect to the effect of humic acid (HA) and compost extract (CE) as a foliar application on macronutrients content of grain and straw of rice plant, data in Table (4) reveal that the highest significant values of N, P and K contents of grain and straw were recorded when foliar application of humic acid was practiced in both seasons compared to no addition of such compounds except for K content of straw which wasn't affected by such treatments in both seasons. On the other hand, P content of grain, N & P contents of straw in first season as well as N and P contents of grain and straw in second season were significantly increased by foliar application of compost extract. Similar results were obtained by Turkmen *et al.* (2004) who showed that humic acid applied to the plant growth medium at 1000 mg/kg concentration increased seedling growth and nutrient contents. Humic acid not only increased macronutrient contents, but also enhanced micronutrient contents of plant organs. Also, Ahmad and Tan (1991) and Chen *et al.* (1994) suggested that the humic acid increased cell membrane, important for the transport and availability of micronutrients, nutrient uptake, stimulates seed germination and viability, oxygen uptake, respiration (esp. in roots) and photosynthesis.

Results in Table (4), show that there weren't significant differences between the interacted factors due to macronutrients content of grains and straw of rice plant in both seasons.

4. Carbohydrates, nitrite and nitrate content of grain rice:

Data for carbohydrate, nitrite and nitrate content of grain rice are shown in Table (5). As a general view, NO_3 in grains was increased significantly when nitrogen at the maximum rate 45 kg N/ fed was added in both seasons while, both levels of nitrogen fertilizer 30 and 45 kg N/ fed gave the highest values of NO_2 in grains compared to first level 15 kg N/ fed in second season only.

As regard to the effect of humic acid and compost extract as a foliar application on carbohydrate, nitrite and nitrate in grain of rice plant, data presented in Table (5) apparently show that the no addition of any organic compounds or foliar application of compost extract increased significantly carbohydrate in grain in the first season, while the lowest one recorded when humic acid as a foliar application was applied. Also, data reveal that foliar spray of humic acid gave significantly higher values of NO_3 in grain compared to no addition of any organic compounds. Meanwhile, the other parameters in Table (5) weren't significantly affected by humic acid and compost extract as a foliar application.

Regarding the interactions between the factors under study, it can be noticed that the treatment of added nitrogen at the maximum rate and foliar application of humic acid significantly achieved the highest NO_3 of rice grain in both seasons, whereas; NO_2 and carbohydrate weren't affected significantly by the interacted factors in both seasons.

Table (5): Effect of N rates and organic compounds on carbohydrates, nitrite and nitrate content of grain rice

Treatments		2007 Season			2008 Season		
N rates	organic compounds	Total carbohydrate %	NO_2 (mg kg^{-1})	NO_3 (mg kg^{-1})	Total carbohydrate %	NO_2 (mg kg^{-1})	NO_3 (mg kg^{-1})
15 kg N/fed.	Without	76.85	1.96	4.023	75.25	2.05	4.37
	C E	76.26	2.08	4.380	74.78	2.14	4.52
	H A	76.05	2.14	4.520	74.93	2.23	4.76
Mains (Average N)		76.39	2.06	4.307	74.99	2.14	4.55
30 kg N/fed.	Without	76.72	2.03	6.170	75.16	2.09	6.39
	C E	76.17	2.19	6.760	74.62	2.30	7.02
	H A	75.94	2.26	7.080	74.50	2.39	7.47
Mains (Average N)		76.28	2.16	6.670	74.76	2.26	6.96
45 kg N/fed.	Without	76.54	2.12	6.530	75.06	2.16	6.60
	C E	76.11	2.27	7.170	74.53	2.44	7.77
	H A	75.90	2.39	7.680	74.42	2.58	8.23
Mains (Average N)		76.18	2.26	7.127	74.67	2.39	7.53
Over all mean for sub plot	Without	76.70	2.04	5.574	75.16	2.10	5.79
	C E	76.18	2.18	6.103	74.64	2.29	6.44
	H A	75.96	2.26	6.427	74.62	2.40	6.82
LSD							
N		NS	NS	0.43	NS	0.14	0.24
Organic compounds		0.61	NS	0.34	NS	NS	0.26
Interaction		NS	NS	0.38	NS	NS	0.29

5. Nitrite and nitrate content in drainage water:

Concerning the effect of nitrogen fertilizer rates on NO_2 and NO_3 content in drainage water at 35 and 50 days from transplanting, data presented in Table (6), apparently show that the highest significant values of such parameters were recorded when the high level of nitrogen fertilizer (45 kg N/fed) was added. On the other hand, low level of N fertilizer 15 kg N/ fed gave the lowest values of such parameters in both seasons. In this connection, Bouwer (1978) stated that the groundwater is that portion of water beneath the surface of the earth that can be collected with wells, tunnels, or drainage galleries, or that flows naturally to the earth's surface via seeps or springs. Also, Owens *et al.* (2000) 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, (Umezawa, *et al.*, 2009 and Bouman, *et al.*, 2002) 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.

Table (6): Effect of N rates and organic compounds on nitrate and nitrite content in drainage water at two stages from transplanting

Treatments		2007 Season				2008 Season			
		35 days		50 days		35 days		50 days	
		NO_2 - N	NO_3 - N	NO_3 - N	NO_2 – N	NO_2 - N	NO_3 - N	NO_2 - N	NO_3 - N
N rates	organic compounds	(mg kg^{-1})							
15 kgN/fed.	Without	2.91	6.38	4.87	10.34	2.67	5.75	4.13	9.13
	C E	2.96	6.46	4.96	10.39	2.72	5.84	4.21	9.26
	H A	3.01	6.49	4.98	10.43	2.79	5.85	4.25	9.30
Mains (Average N)		2.96	6.44	4.94	10.39	2.73	5.81	4.20	9.23
30 kgN/fed.	Without	4.04	9.73	6.53	11.91	4.13	7.94	5.87	11.22
	C E	4.88	9.76	6.66	11.97	4.18	8.02	5.93	11.36
	H A	4.91	9.77	6.72	11.98	4.19	8.04	6.41	11.40
Mains (Average N)		4.61	9.75	6.64	11.95	4.17	8.00	6.07	11.33
45 kgN/fed.	Without	6.22	13.06	8.79	14.07	5.83	10.87	8.33	13.09
	C E	6.33	13.17	8.88	14.29	5.86	10.98	8.37	13.17
	H A	6.29	13.23	8.92	14.33	5.94	11.03	8.43	13.13
Mains (Average N)		6.28	13.15	8.86	14.23	5.88	10.96	8.38	13.13
Over all mean for sub plot	Without	4.39	9.72	6.73	12.11	4.21	8.19	6.11	11.15
	C E	4.72	9.80	6.83	12.22	4.25	8.28	6.17	11.26
	H A	4.74	9.83	6.87	12.25	4.31	8.31	6.36	11.28
LSD									
N		0.73	0.38	0.18	0.22	0.30	0.28	0.63	0.19
Organic compounds		NS	NS	NS	NS	NS	NS	NS	NS
Interaction		NS	NS	NS	NS	NS	NS	NS	NS

Data available in Table (6) reveal that there weren't significant effect due to foliar application of humic acid, compost extract and control treatment (no addition of any organic compounds) on NO_2^- and NO_3^- content in drainage water in 35 and 50 days from transplanting in both seasons. The concentrations of inorganic N in the soil solutions throughout the vertical soil profile were mainly dominated by NH_4^+ ion rather than NO_3^-because the source of N fertilizer was ammonium chloride. Significant increase in NO_3^-N in the soil solution was only observed 75 days after fertilizer application. This implied that nitrification was relatively slow in the soil during the monsoon period. This might be attributed to the high NH4+ concentration which inhibits the activity of nitrifies in the soils and the low soil organic matter which reduces the population of nitrifies (Erickson, *et al.*, 2001). In this respect, XU *et al.* (2008) 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.

Results in Table (6) show that there weren't significant differences between the interacted factors on NO_2 and NO_3 content in drainage water at 35 and 50 days from transplanting in both seasons. This result could be attributed to the individual effect aforementioned of the factors under study. It is worthwhile to mention that the effect of nitrogen fertilizer especially at the high rates and foliar application of humic acid or compost extract were more pronounced than the interacted factor under study.

Subsequently, in conclusion, this report shows that the treatment of 45 kg N/ fed with humic acid or compost extract as a foliar spray can remarkably increase the yield and its components as well as macronutrients content of rice plant .

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تأثير التسميد النيتروجينى وحامض الهيوميك ومستخلص الكمبوست على محصول وجودة نباتات الأرز

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أقيمت تجربتين حقليتين فى محطة البحوث الزراعية بالجميزة التابعة لمركز البحوث الزراعية- بمحافظة الغربية.خلال موسمين زراعيين متتاليين ٢٠٠٧ و ٢٠٠٨ لدراسة تأثير معدلات من السماد النيتروجينى (١٥ ، ٣٠و ٤٥ كجم نيتروجين / فدان و الرش بحامض الهيوميك و مستخلص الكمبوست على محصول الارز ومكوناته و التركيب الكيماوى له وكذلك محتوى مياه الصرف من النيتريت والنترات عند أعمار مختلفة من عمر الشتل.

وكانت أهم النتائج كما يلى:-

١- بصفة عامة، أعطى المعدل العالى من السماد الازوتى أعلى زيادة معنوية لمحصول الارز ومكوناته وأيضا الممتص من النيتروجين والفوسفور و البوتاسيوم فى الحبوب والقش مقارنة بالمعدل المنخفض من السماد الازوتى فى كلا الموسمين.

٢- أعطى الرش بحامض الهيوميك او مستخلص الكمبوست تفوقا معنويا فى معظم صفات المحصول ومكوناته وكذلك الممتص من النيتروجين والفوسفور و البوتاسيوم فى الحبوب والقش مقارنة بمعاملة بدون رش اى من المركبات العضوية فى كلا الموسمين.

٣- فى معظم الحالات، لم يكن لتأثير التفاعل بين العناصر تحت الدراسة اى تأثير معنوى على محصول الارز ومكوناته وأيضا الممتص من النيتروجين والفوسفور و البوتاسيوم فى الحبوب والقش فى كلا الموسمين.

٤- أعطى المعدل العالى من السماد الازوتى أعلى زيادة معنوية فى محتوى مياه الصرف من النيتريت و النترات فى الأعمار المختلفة من عمر الشتل مقارنة بالمستوى المنخفض من السماد الازوتى فى كلا الموسمين . من ناحية أخرى لم تتأثر معنويا هذه الصفات بإضافة المركبات العضوية أو التفاعل بين معدلات السماد الازوتى والرش بالمركبات العضوية فى كلا الموسمين.

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