J. Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 6 (8): 911 - 925, 2015

INFLUENCE OF IRRIGATION WATER TYPES AND ORGANIC MANURES ON RICE PRODUCTION

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ABSTRACT

A field experiment was conducted at Research Farm of Agronomy Dept., Fac. Agric., Mansoura Univ., Mansoura, Egypt for a period of one year (2014) to find out the effect of irrigation water types and organic manures on some soil chemical properties and yield of rice crop (*Var.*, 104). A strip plot design was used with three replications, the irrigation water types (I) were industrial wastewater, agricultural drainage water and normal irrigation water. The organic manures (T) consisted of FYM, compost, and FYM + compost, These treatments were given in rate of 5 and 2 t fed^{-1}. The plants without treatments were served as a control. The results illustrate that, the soil pH was decreased while soil EC was increased significantly due to using industrial and agricultural drainage water in combination with organic manure treatments. The highest soil pH was recorded by the treatments I_1T_2 (7.62), I_3T_4 (7.66) and I_2T_4 (7.35) at vegetative, tillering and harvest stages, respectively. The treatments I_1T_4, I_2T_4 and I_1T_2 recorded the highest soil EC (ppm) at vegetative (522), tillering (291) and harvest (394) stages, respectively. The obtained data illustrate that, using of normal irrigation water (I_3) combined with addition of FYM + Compost @ recommended doses (T_4) recorded the highest (5416 kg fed^{-1}) grain yield of rice crop followed by I_3T_3 (4415 kg fed^{-1}), I_2T_4 (4292 kg fed^{-1}), I_3T_2 (4195 kg fed^{-1}) and I_3T_1 (4050 kg fed^{-1}). Also, under use of different irrigation water, the addition of compost @ 2 t fed^{-1} (T_3) was found to be superior than application of FYM @ 5 t fed^{-1} (T_2) in registering the highest grain and straw yield of rice crop.

Keywords: Industrial wastewater, Agricultural drainage water, Organic manure, Rice, Soil pH, Soil EC, Grain yield, Straw yield.

INTRODUCTION

Water is a major factor on earth and top priority for the existence of human life and crop production. The shortage of water resources has become a major issue for agriculture in many parts around the world (Gassama *et al.*, 2015). Consequently, wastewater reuse has attracted public attention as an alternative water source in many countries (Rhee *et al.*, 2011 & Padhan and Sahu, 2011). Reuse for agriculture has already been applied in nearly 120 countries (US EPA, 1992). After proper dilution, wastewater can be used as a potential source of water for seed germination and plant growth in agricultural practice (Dash, 2012). The agricultural use of wastewater helps to preserve environmental quality and concurrently furthers other national goals such as providing sustainable agriculture while preserving scarce water sources (Chung *et al.*, 2011). The reuse of wastewater has the advantage of increasing agricultural production and alleviating water quality problems owing to a reduction in the discharge of wastewater (Jung *et al.*, 2005).

Egypt started to pay attention to reuse of drainage water for irrigation in order to, cover the shortage of fresh water and meet their demands for more food production. The drainage water supplies all or even more heavy metals to the soil. In some areas, this water is polluted by the sewage effluents which are damped into the agriculture drainage system. In North Delta region, the soils irrigated with drainage water polluted by wastewater of industrial effluent were higher in heavy metals content than the normal soil (El-Habet Howida, 2009). The effluent of wastewater treatment plants, however, generally contains high levels of microorganisms and various heavy metals. Therefore, adverse human health effects and sanitation problems must be carefully considered (Peasey *et al.*, (2000).

Utilization of organic manure has been a rather common conventional practice and this gives them an upper hand and makes them more suitable for maintaining soil fertility and improving crop yield and quality (Zhang *et al.*, 1998). The organic manures have the benefit of supplying macro (Radha *et al.*, 1999) and secondary nutrients along with micronutrients (Kumar and Yadav, 2003), enhancing soil physical characteristics *viz.*, soil aggregation (Rasmussen and Collins, 1991), bulk density & water-holding capacity (Meelu, 1996 and Edmeades, 2003) and hydraulic conductivity (Mathan, 2000) as well as chemical properties *viz.*, CEC (Patiram, 1993), soil organic carbon (Maheswarappa *et al.*, 1999 and Katkar *et al.*, 2002), providing energy for microbes (Gaur *et al.*, 1984), increasing the availability of nutrients (Prasad, 1996; Kumar and Yadav, 2003 & Tolanur and Badanur, 2003) and improving soil fertility (Aich *et al.*, 1997). It is well documented that the complementary use of organic manures and chemical fertilizers has proven to be the best strategy for soil fertility management (Fageria and Baligar, 2005).

Among the field crops, rice (*Oryza sativa* L.) is the second most important cereal crops of the world's, grown in a wide range of climatic zones (Maclean *et al.*, 2002). Rice is the staple food for nearly half of the world‘s population, most of whom live in developing countries (Mahamud *et al.*, 2013). The crop occupies one-third of the world‘s total area planted to cereals and provides 35 to 60% of the calories consumed by 2.7 billion people (Tayefe *et al.*, 2014). The production of paddy rice requires large volumes of water and fields are flooded before plowing. The water level is kept at 4-6 cm in shallow rice fields and as high as 10 cm in continuous flooding irrigation during the growing season (Rath *et al.*, 2000).

Hence, the present investigation was contemplated to study the effect of both irrigation water types and organic manures alone or in combination with each other on some soil chemical properties as well as grain and straw yield of rice crop.

MATERIALS AND METHODS

A field experiment was carried out at the Research Farm of Agronomy Dept., Fac. Agric., Mansoura Univ., Mansoura, Egypt in the summer season (April - September) for a period of one year (2014) using rice (*Var.*, 104) as test crop. The initial soil sample from the experiment was air dried, grinded, passed through 2 mm sieve and analyzed (Table 1) for particle size distribution and total carbonate ($CaCO_3$%) as described by (Piper, 1950**)**. Soil pH and electrical conductivity (EC) were determined by the procedures given by (Richards, 1954). Bulk density was determined by the procedure given by (Dewis and Freitas, 1970) while, particle density was determined according to (Black *et al.*, 1965). Porosity (E%) was calculated according to (Hillel, 1980). Ammonical ($N\text{-}NH_4^+$) and nitratic nitrogen ($N\text{-}NO_3^-$) were measured according to (Bremner and Keeney, 1966). Soil available phosphorus (P) was determined colorimetrically using ascorbic acid as described by (van Schouwenburg and Walinga, 1967). Soil available potassium (K), organic matter content and amounts of soil soluble ions were determined according to (Hesse, 1971).

Table 1: Initial soil characteristics of the experimental plot.

Parameters	Value	Parameters	Value
Sand (%)	11.69	Soluble cations (meq L^{-1})	
Silt (%)	37.17	Ca^{++}	0.60
Clay (%)	51.14	Mg^{++}	0.90
Texture class	Clay	K^+	0.70
		Na^+	0.28
ρb (Mg m^{-3})	1.14	Soluble anions (meq L^{-1})	
ρs (Mg m^{-3})	2.19	CO_3^{--}	0.00
Total porosity (%)	48.00	HCO_3^-	0.23
		Cl^-	1.29
pH*	7.71	SO_4^{--}	0.89
EC** (dSm^{-1})	0.25	Available nutrients (ppm)	
		$N\text{-}NH_4^+$	18.23
$CaCO_3$%	1.03	$N\text{-}NO_3^-$	7.84
OM%	0.84	Phosphorus (P)	8.30
		Potassium (K)	350
*	**pH was determined in soil paste.**		
**	**EC was determined in soil paste extract.**		

The N content in the organic manure samples used during the experiment (Table 2) was determined by micro kjeldahl method Humphries (1956). Total P and K contents were extracted by digestion with diacid (H_2SO_4:$HClO_4$, 5:2), the P was estimated colorimetrically as vanado-molybophosphate yellow color complex and K was determined by the flame photometer. Micronutrients in the diacid extract was analyzed by Atomic Absorption Spectrophotometer (Jackson, 1973). The organic carbon content was determined by Chromic acid wet digestion method (Walkley and Black, 1934).

The wastewater were collected every five days and kept in a polyethylene tank. The Industrial wastewater was pumped from a drain nearby the outlet of Delta Company for Fertilizers & Chemical Industries, Talkha District, Dakahlia while the agricultural drainage water was collected from an agriculture drain near Mit Khames Village, Mansoura District, Dakahlia. The River Nile water was used as a source for normal irrigation water. The water samples were analyzed (Table 3) for soil pH and EC by the procedures given by (Richards, 1954). The amount of soluble ions were determined by according to (Hesse, 1971).

Table 2: Nutrient content of the organic manures used for the study.

Parameters		Farmyard manure	Compost
Total N	(%)	1.14	1.96
Total P	(%)	0.79	0.48
Total K	(%)	0.40	1.10
Total Fe	(mg kg^{-1})	305	429
Total Zn	(mg kg^{-1})	23.2	58.0
Total Mn	(mg kg^{-1})	47.7	40.4
Organic Carbon	(%)	29.5	36.2
C:N ratio		25:1	18:1

Table 3: Characteristics of the irrigation water used for the study.

Parameters	Industrial wastewater	Agriculture drainage water	Normal irrigation water
pH	7.95	7.50	7.12
EC (dSm^{-1})	2.92	1.12	0.38
$SAR_{Adj.}$	11.5	9.73	5.23
RSC	2.41	1.07	0.32
B (ppm)	0.61	0.53	0.22
Pb (ppm)	9.207	8.071	0.270
Ni (ppm)	0.398	0.456	0.021

Twelve treatments consisted of three types of irrigation water (industrial wastewater, agricultural drainage water and normal irrigation water) in combination with four levels of organic manures (without organic manures, farmyard manure @ 5 t fed^{-1}, compost @ 2 t fed^{-1} and farmyard manure & compost @ the recommended doses) were laid out in a strip plot design with three replications as follows: T_1: NPK + industrial wastewater, T_2: NPK + agricultural drainage water, T_3: NPK + normal irrigation water, T_4: NPK + industrial wastewater + FYM @ 5 t fed^{-1}, T_5: NPK + agricultural drainage water + FYM @ 5 t fed^{-1}, T_6: NPK + normal irrigation water + FYM @ 5 t fed^{-1}, T_7: NPK + industrial wastewater + compost @ 2 t fed^{-1}, T_8: NPK + agricultural drainage water + compost @ 2 t fed^{-1}, T_9: NPK + normal irrigation water + compost @ 2 t fed^{-1}, T_{10}: NPK + industrial wastewater + FYM + compost @ RD, T_{11}: NPK + agricultural drainage water + FYM + compost @ RD and T_{12}: NPK + normal irrigation water + FYM + compost @ RD.

To avoid the percolation of water into the ground and from strip to another, soil was removed for a depth of 75 cm and a polyethylene black sheet was spread and covered again with the soil. The chemical form of nitrogen, phosphorus and potassium fertilizers were applied in the form of urea, single super phosphate and potassium sulphate at 200, 100 and 50 kg fed^{-1}, respectively as per the blanket recommendation of Ministry of Agriculture. The full of P, K and two-third quantity of N were applied as per treatment schedule before flooding as basal and the one-third was applied one month after transplanting. The whole amount of organic manures were incorporated with soil as per treatment schedule at the time of transplanting as basal dressing. Surface irrigation was given and other intercultural operations were carried out as recommended by Ministry of Agriculture. At harvest stage, the soil samples were analyzed for pH and EC (Richards, 1954). The grain and straw yield were recorded.

RESULTS AND DISCUSSION

1. Changes of the soil pH

The effect of irrigation water found to be significant at tillering stage and highly significant at harvest stage (Table 4). The supply of industrial wastewater to the rice crop (I_1) recorded the highest mean values at vegetative stage (7.43) and tillering stage (7.37) while the same treatment recorded the lowest mean value at harvest stage (7.19). It was noticed that, there is a negligible decrease at the beginning of growth (vegetative stage) while at the end of growth (harvest stage), there is a slight increase.

Table 4: Effect of irrigation water types, organic manures and their interactions on soil pH at different growth stages of rice crop.

Treatments	Soil pH											
	1st Stage				2nd Stage				3rd Stage			
A: Irrigation (I)												
I_1	7.43				7.37				7.19			
I_2	7.43				7.25				7.28			
I_3	7.40				7.33				7.29			
F - Test	-				*				**			
LSD 5%	NS				0.07				0.03			
B: Manures (T)												
T_1	7.55				7.23				7.22			
T_2	7.42				7.36				7.23			
T_3	7.52				7.19				7.23			
T_4	7.17				7.49				7.32			
F - Test	**				**				**			
LSD 5%	0.03				0.06				0.03			
C: Interaction (I×T)												
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
I_1	7.57	7.62	7.54	6.97	7.16	7.61	7.22	7.51	7.10	7.12	7.24	7.30
I_2	7.51	7.57	7.58	7.04	7.21	7.27	7.22	7.29	7.27	7.26	7.22	7.35
I_3	7.56	7.08	7.45	7.50	7.32	7.20	7.13	7.66	7.30	7.32	7.24	7.30
F - Test	**				**				**			
LSD 5%	0.07				0.12				0.06			

The effect of organic manure doses was highly significant at all stages of rice crop growth. The highest mean values were recorded by treatment T_1 (without organic manure, 7.55) followed by T_3 (application of compost @ 2 t fed^{-1}, 7.52) and both of them were found to be on a par at the vegetative stage (1st stage) while the same treatments recorded the lowest mean values at 2nd (tillering stage) and 3rd stages (harvest stage). The treatments T_1 and T_3 were found to be on a par with themselves at vegetative stage and with T_2

(application of FYM @ 5 t fed^{-1}, 7.23) at harvest stage. The application of FYM and compost at the recommended doses (T_4) was recorded the lowest mean value (7.17) at vegetative while it was recorded the highest mean values at the tillering (7.49) and harvest (7.32) stages. At the beginning of growth, there is no clear trend while at the end of growth, there is a slight increase in soil pH.

The interaction of irrigation water types and organic manures doses had a significant effect on the soil pH at all stages of rice crop growth (Table 4 and Fig. 1). The highest soil pH was recorded by the treatments I_1T_2 (7.62), I_3T_4 (7.66) and I_2T_4 (7.35) at vegetative, tillering and harvest stages, respectively. On the other hand, the lowest mean values for soil pH were recorded by the treatments I_1T_4 (6.97), I_3T_3 (7.13) and I_1T_4 (7.10) at 60^{th} and 90^{th} and 140^{th} DAT, respectively. The data revealed that, the treatments T_2, T_3 and T_4 were found to be comparable among themselves under using of any irrigation water type.

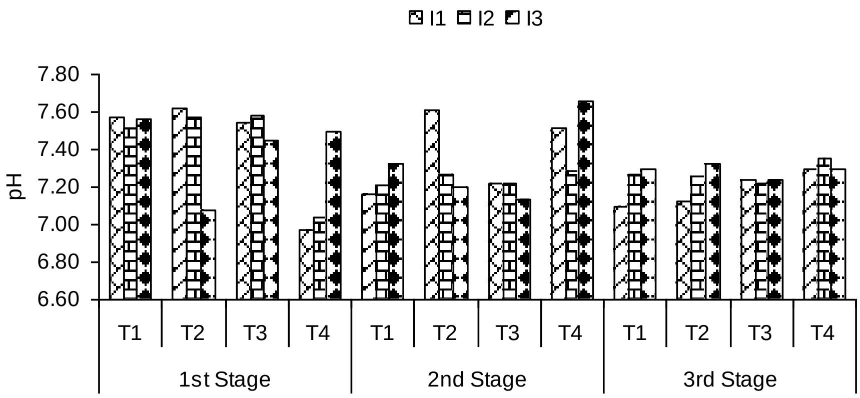

Fig. 1: Effect of interaction between irrigation water types and organic manures on soil pH.

The decrease of soil pH could be due to ammonium (NH_4^+) nitrification, which releases free hydrogen ions (H^+) in the soil, therefore, lowering the soil pH. This reduction of soil pH is slightly important with application of wastewater, which corroborates the findings of Yadav *et al.*, 2002 & Herpin *et al.*, 2007. The higher concentrations of NH_4^+ ions in wastewater may lead to a higher rate of nitrification releasing free H^+ ions in the soil, consequently lowering more the soil pH. A reduction in soil pH due to wastewater irrigation has been reported by Mohammad and Mazahreh (2003) & Singh and Agrawal (2012). Some investigations showed that the irrigation with wastewater increased the soil pH (AL-Jaboobi *et al.*, 2013). The most investigations described the long-term impact of irrigation with sewage and wastewater effluents on soil properties while our study was short term.

The irrigation of soil with wastewater may cause at first a decrease of pH, but after a while it may cause an increase of soil pH. Furthermore, The decrease in the soil pH could be due to the organic acids released as a result of organic matter fermentation processes expected to be dominated in soil under flooded conditions (Yanni, 1979 & Chen and Avnimelech 1986). The increase of the soil pH in the later stages (harvest) of rice growth may partially be due to the consumption of the organic acids by sulphate (SO_4^{--}) reducers as electron donors to reduce SO_4^{--}, which act electron acceptor (Yanni, 1979 and Stevenson, 1995).

2. Changes of the soil EC

The effect of irrigation water types was highly significant on soil EC at all stages of rice crop (Table 5). The data indicate that, the highest mean values of soil EC were recorded by addition of agricultural drainage water (I_2) at vegetative (60^{th} DAT) and tillering (90^{th} DAT) stages while at harvest stage (140^{th} DAT) the application of industrial wastewater (I_1) registered the highest mean values. The recorded mean values were 358, 278 and 373 ppm at the particular growth stages, respectively. The use of industrial wastewater (I_1) was found to be comparable with addition of agricultural drainage water (I_2) at the beginning of rice crop growth (345 and 271 ppm) while at later stage the treatment I_1 excels I_2 (308 ppm).

Table 5: Effect of irrigation water types, organic manures and their interactions on soil EC at different growth stages of rice crop.

Treatments	Soil EC (ppm)											
	1st Stage				2nd Stage				3rd Stage			
A: Irrigation (I)												
I_1	345				271				373			
I_2	358				278				308			
I_3	239				212				196			
F - Test	**				**				**			
LSD 5%	43.6				10.9				14.9			
B: Manures (T)												
T_1	239				246				257			
T_2	322				251				291			
T_3	275				262				321			
T_4	419				257				299			
F - Test	**				NS				**			
LSD 5%	21.1				-				11.1			
C: Interaction (I×T)												
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
I_1	314	272	271	522	265	257	277	284	366	394	368	362
I_2	216	369	336	483	266	266	291	291	227	277	391	339
I_3	187	299	218	215	206	229	219	195	179	202	205	196
F - Test	**				**				**			
LSD 5%	53.4				21.7				22.1			

The effect of organic manure doses was highly significant at almost (vegetative and harvest) stages of growth. The highest mean values were recorded by treatment T_4 (addition of FYM and compost at the recommended doses, 419 ppm) at vegetative stage while at harvest stage the highest mean values were recorded by T_3 (application of compost @ 2 t fed^{-1}, 321 ppm) while the treatment T_4 recorded the second highest mean value (299 ppm) and it was found to be on a par with T_2 (application of FYM @ 5 t fed^{-1}, 291 ppm).

The interaction effect between irrigation water types and organic manures was found to be significant at all stages of rice crop growth (Table 5 and Fig. 2). The treatments I_1T_4, I_2T_4 and I_1T_2 recorded the highest mean values of soil EC at vegetative (522 ppm), tillering (291 ppm) and harvest (394 ppm) stages, respectively while the lowest were registered by the treatments I_3T_1 (187 ppm), I_3T_4 (195 ppm) and I_3T_1 (179 ppm) at 60th and 90th and 140th DAT, respectively. The data demonstrate that, the treatments T_2, T_3 and T_4 recorded the highest soil EC with using of any type of irrigation water while, the treatment T_1 recorded the lowest soil EC with using of normal irrigation water.

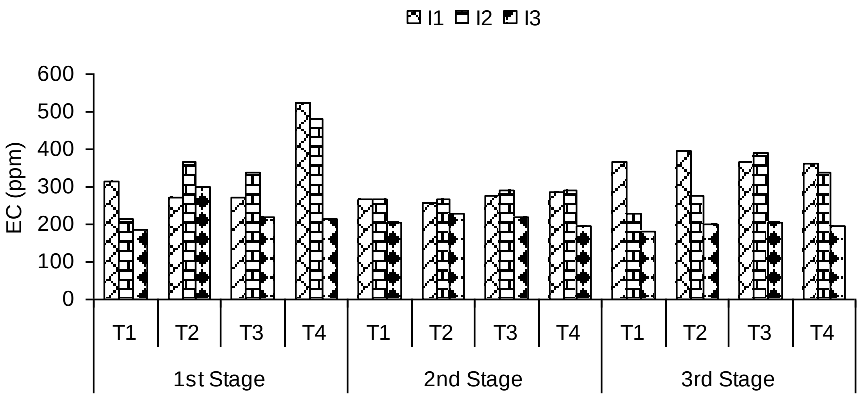

Fig. 2: Effect of interaction between irrigation water types and organic manures on soil EC.

Soil EC is a parameter that indicates indirectly the total concentration of soluble salts and is a direct measurement of salinity. It is the most important indicator regarding to fields irrigated with wastewater. EC of soils irrigated with wastewater increased because of higher EC of wastewater, this is in harmony with findings of Jahantigh, (2008). The higher concentration of cations in wastewater led to an increase in EC of soils irrigated with wastewater (Khai *et al.* 2008). Also, Incorporation of organic manures into soil increases the salt content as well as soil EC, especially if high doses of compost are applied, because of the high salinity of composts (Gallardo-Lara and Nogales, 1987). Similar results have been reported in the literature of Selvakumari *et al.*, (2000), Sarwar *et al.*, (2003) and Angelova *et al.*, (2013) which indicated that EC increased in acidic and alkaline soils when organic materials of different nature were applied to the soil. Indeed, salinity is possible to combat by applying more normal water than the plant needs to remove the salts from the root zone by leaching.

3. Grain and straw yield of rice crop

The effect of adding different types of irrigation water significantly influenced the grain and straw yield of rice crop at harvest stage (Table 6). The use of normal irrigation water (I_3) registered the highest grain and straw yield of rice crop followed by addition of agricultural drainage water (I_2) and Industrial wastewater (I_1). The recorded mean values were 4519, 3326 & 2289 (grain) and 4599, 4146 & 3614 (straw) kg fed^{-1} for I_1, I_2 and I_3, respectively. The data indicate that, the treatment I_3 gave the highest yield with increasing of 49.34 & 31.17% (grain yield) and 9.85 & 12.82% (straw yield) over the treatments I_2 and I_1, respectively.

Table 6: Effect of irrigation water types, organic manures and their interactions on grain and straw yield of rice crop at harvest stage.

Treatments	**Yield, (kg fed^{-1})**							
	Grain				**Straw**			
A: Irrigation (I)								
I_1	2289				3614			
I_2	3326				4146			
I_3	4519				4599			
F - Test	**				**			
LSD 5%	181				91			
B: Manures (T)								
T_1	2782				3446			
T_2	2942				4627			
T_3	3684				4273			
T_4	4104				4133			
F - Test	**				**			
LSD 5%	25				13			
C: Interaction (I×T)								
	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
I_1	1508	2111	2932	2604	2453	4556	3655	3793
I_2	2782	2520	3704	4292	3375	4662	4250	4296
I_3	4050	4195	4415	5416	4509	4662	4913	4309
F - Test	**				**			
LSD 5%	184				92			

The addition of different doses of organic manure significantly influenced the grain and straw yield of rice crop at harvest stage (140 DAT). The addition of FYM + Compost @ the recommended doses (T_4) recorded the highest mean values for grain yield followed by treatments T_3 (application of compost @ 2 t fed^{-1}) and T_2 (application of FYM @ 5 t fed^{-1}). The registered mean values were 4104, 3684 and 2942 kg grain fed^{-1}. The data illustrate that, the treatment T_4, recorded the highest grain yield with increasing of 32.21, 28.31 and 10.23% over the treatments T_1, T_2 and T_3, respectively. Regarding the straw yield, the treatment T_2 recorded the highest mean values followed by T_3 and T_4. The registered mean values were 4627, 4273 and 4133 kg straw fed^{-1}. The data indicate that, the treatment T_2 gave the highest straw yield with an increase of 27.68% over treatment T_1 (without organic manure).

The interaction between irrigation water types and organic manure doses significantly affected the grain and straw yield of rice crop at harvest stage (Table 6 and Fig. 3). The data indicate that the treatment T_4 (addition of FYM + Compost @ recommended doses) recorded the highest mean values under using of normal irrigation water (I_3, 5416 kg fed^{-1}) followed by I_3T_3 (4415 kg fed^{-1}), I_2T_4 (4292 kg fed^{-1}), I_3T_2 (4195 kg fed^{-1}) and I_3T_1 (4050 kg fed^{-1}). The data indicate that under use of different irrigation water, the addition of compost @ 2 t fed^{-1} (T_3) excel the application of FYM @ 5 t fed^{-1} (T_2). The recorded mean values were 2932 (I_1T_3), 3704 (I_2T_3) and 4415 (I_3T_3) kg grain fed^{-1}. The use of industrial wastewater (I_1) with the treatment, T_1 (without organic manure) recorded the lowest (1508 kg fed^{-1}) grain yield of rice crop at harvest stage. The utilization of normal irrigation water (I_3) with addition of compost @ 2 t fed^{-1} (T_3) recorded the highest (4913 kg fed^{-1}) straw yield followed by the application of FYM @ 5 t fed^{-1} (T_2) under using of either agricultural drainage water (I_2, 4662 kg fed^{-1}) or normal irrigation water (I_3, 4662 kg fe^{-1}) and both of them were on a par among themselves. The lowest straw yield of rice crop was recorded by treatment T_1 (without organic manure) when soil irrigated with industrial wastewater (I_1, 2453 kg fed^{-1}).

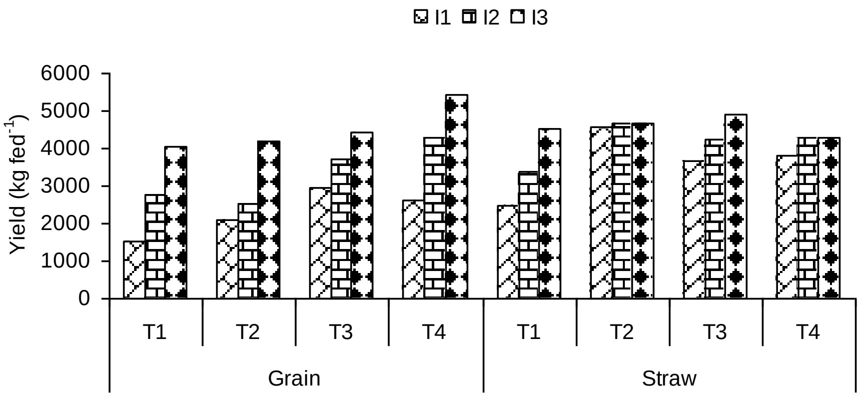

Fig. 3: Effect of interaction between irrigation water types and organic manures on grain and straw yield of rice crop.

Markedly reduced grain and straw yield with wastewater irrigation was remarkable since this water had contained high concentration of toxic heavy metals *viz.*, As, Cr, Hg, Ni, Pb and Se. These elements might have exerted toxic effects to rice plants leading to reduce root elongation (Yamaguchi and Aso, 1977), decrease net photosynthesis (Austenfeld, 1979) and hamper physiological function in rice plants, which leads to reduce plant height, decrease number of effective tillers per hill and very poor straw yield, which eventually resulted in drastic reduction of grain yield. This finding agrees with whose obtained by Yagdi *et al.*, (2000) and Begum *et al.*, (2011) where they observed that toxicity of heavy metals decreased plant growth and development.

SUMMERY AND CONCLUSION

The reuse of wastewater for purposes such as agricultural irrigation can reduce the amount of water that needs to be extracted from environmental water sources. Wastewater can be safely used for irrigation in flooded rice soil with the recommended doses of organic manures under current study. More efficient technology to reduce environmental pollution is using organic manures, which can instead of burring beside mineral fertilizer. Integration of wastewater with organic manures (FYM and compost) can help to produce high and good quality of yield crops. The right utilization of organic manures could be helped to reduce the toxicity of wastewater from heavy metals, produce appreciable yield crops and resolve the high problem of crop residues.

REFERENCES

Aich, A.C.; A.H.M. Ahmed and R. Mandal (1997). Impact of organic matter, lime and gypsum on grain yield of wheat in salt affected soils irrigated with different grades of brackish water. Res., 10(1-2):79-84.

AL-Jaboobi, M.; M. Bouksaim; M. Tijane and S. EL-Ariqi (2013). Agricultural quality evaluation of wastewater used in yemen vegetables production. Middle-East J. Sci. Res., 16(5):667-677.

Angelova, V.R.; V.I. Akova; N.S. Artinova and K.I. Ivanov (2013). The effect of organic amendments on soil chemical characteristics. Bulgarian J. Agric. Sci., 19(5):958-971.

Austenfeld, F.A. (1979). The effect of Ni, Co and Cr on net photosynthesis of primary and secondary leaves of *Phaseolus vulgaris* L. Photosynthetica 13:434-438.

Begum, R.A.; M.W. Zaman; A.T.M.A.I. Mondol; M.S. Islam and K.M.F. Hossain (2011). Effects of textile industrial waste water and uptake of nutrients on the yield of rice. Bangladesh J. Agril. Res., 36(2):319-331.

Black, C.A.; D.D. Evans; L.E. Ensminger; J.L. White and F.E. Clark (1965). "Methods of Soil Analysis". Part 1 and 2. Amer. Soc. Agron. Inc. Pub., Madison, USA.

Bremner, J.M. and D.R. Keeney (1966). Determination and isotope-ratio analysis of different forms of nitrogen in soils: 3. exchangeable ammonium, nitrate, and nitrite by extraction-distillation methods. Soil Sci. Soc. Am. J., 30(5):577-582.

Chen, Y. and Y. Avnimelech (1986). "The Role of Organic Matter in Modern Agriculture". Martinus Nijhoff Publishers, Dordrecht, The Netherlands.

Chung, B.Y.; C.H. Song; B.J. Park and J.Y. Cho (2011). Heavy metals in brown rice (*Oryza sativa* L.) and soil after long-term irrigation of wastewater discharged from domestic sewage treatment plants. Pedosphere 21(5):621-627.

Dash, A.K. (2012). Impact of domestic waste water on seed germination and physiological parameters of rice and wheat. Int. J. Res. Rev. Appl. Sci., 12(2):280-286.

Dewis, J. and F. Freitas (1970). "Physical and Chemical Methods of Soil and Water Analysis". FAO Soils Bull. 10. FAO, Rome, Italy.

Edmeades, D.C. (2003). The long-term effects of manures and fertilizers on soil productivity and quality: a review. Nutr. Cycl. Agroecosyst., 66(2):165-180.

El-Habet Howida, B.I. (2009). Behavior of magnesium and some heavy metals in rice soils irrigated with drainage water and fertilized with organic fertilizer. Ph.D. Thesis, Soils Dept., Fac. Agric., Mansoura Univ., Mansoura, Egypt.

Fageria, N.K. and V.C. Baligar (2005). Nutrient availability. *In:* "Encyclopedia of Soils in the Environment", (Hillel D., Ed.,). Elsevier, San Diego, CA. pp. 63-71.

Gallardo-Lara, F. and R. Nogales (1987). Effect of the application of town refuse compost on the soil-plant system: A review. Biol. Wastes 19(1):35-62.

Gassama, U.; A. Puteh; M. Abd-Halim and B. Kargbo (2015). Influence of municipal wastewater on rice seed germination, seedling performance, nutrient uptake and chlorophyll content. J. Crop Sci. Biotech., 18(1):9-19.

Gaur, A.C.; S. Neelakantan and K.S. Dargan (1984). Organic Manures, Indian Council of Agricultural Research, New Delhi, India, p. 159.

Herpin, U.; T.V. Gloaguen; A.F. da Fonseca; C.R. Montes; F.C. Mendonça; R.P. Piveli; G. Breulmann; M.C. Forti and A.J. Melfi (2007). Chemical effects on the soil-plant system in a secondary treated wastewater irrigated coffee plantation - A pilot field study in Brazil. Agr. Water Manage., 89(1-2):105-115.

Hesse, P.R. (1971). "A Textbook of Soil Chemical Analysis". John Murray (Publishers) Ltd., 50 Albemarle St., London, UK.

Hillel, D. (1980). "Introduction of Soil Physics". Academic Press, Orlando, Florida, USA.

Humphries, E.C. (1956). Mineral components and ash analysis. *In*: "Modern Methods of Plant Analysis". Springer Berlin Heidelberg. pp. 468-502.

Jackson, M.L. (1973). "Soil Chemical Analysis". Prentice Hall of India Pvt. Ltd., New Delhi, India.

Jahantigh, M. (2008). Impact of recycled wastewater irrigation on soil chemical properties in an Arid region. Pak. J. Biol. Sci., 11(18):2264-2268.

Jung, K.W.; C.G. Yoon; J.H. Jang; H.C. Kim and J.H. Jeon (2005). Investigation of indicator microorganism concentrations after reclaimed water irrigation in paddy rice plots. J. Korean Soc. Agric. Eng., 47(4):75-85.

Katkar, R.N.; A.B. Turkhede; V.M. Solanke and S.T. Wankhade (2002). Response of cotton to integrated management of various types of organic manures and fertilizers. Crop Res., 23(1):194-197.

Kumar, A. and D.S. Yadav (2003). Long-term nutrient management for sustainability in rice-wheat cropping system. Fert. News 48(8):27-34.

Maclean, J.L.; D.C. Dawe; B. Hardy and G.P. Hettel (2002). Rice Almanac: Source book for the most important economic activity on earth, 3rd Ed., CABI Publishing, Wallingford, Oxon, UK & International Rice Research Institute (IRRI), Metro Manila, Philippines.

Mahamud, J.A.; M.M. Haque and M. Hasanuzzaman (2013). Growth, dry matter production and yield performance of transplanted *Aman* rice varieties influenced by seedling densities per hill. Intl. J. Sustain. Agric., 5(1):16-24.

Maheswarappa, H.; H.V. Nanjappa and M.R. Hegde (1999). Influence of organic manures on yield of arrow root, soil physico-chemical and biological properties when grown as a intercrop in coconut garden. Ann. Agric. Res., 20:318-323.

Mathan, K.K. (2000). Impact of biological waste on soil physical properties and yield maize and finger millet. Madras Agric. J., 87(10-12):618-620.

Meelu, O.P. (1996). Integrated nutrient management for ecologically sustainable agriculture. J. Indian Soc. Soil Sci., 44(4):582-592.

Mengel, K. and E.A. Kirkby (2001). "Principles of Plant Nutrition", 5th Ed., Kluwer Academic Publishers, Dordrecht, The Netherlands.

Mohammad M.J. and N. Mazahreh (2003). Changes in soil fertility parameters in response to irrigation of forage crops with secondary treated wastewater. Commun. Soil Sci. Plant Anal., 34(9-10):1281-1294.

Padhan, A. and S.K. Sahu (2011). Effect of rice mill waste water on population, biomass, rate of reproduction and secondary production of *Drawida willsi* (oligochaeta) in rice field agroecosystem. Int. J. Res. Rev. Appl. Sci., 6(2):138-146.

Patiram, S.K.A. (1993). Effect of continuous application of manure and nitrogenous fertilizer on some properties of acid Inceptisol. J. Indian Soc. Soil Sci., 41(3):430-433.

Peasey, A.; U.J. Blumenthal; D.D. Mara and G. Ruiz-Palacios (2000). A review of policy and standards for wastewater reuse in agriculture: a Latin American perspective, Vol 68. WELL Study, London School of Hygiene & Tropical Medicine, WEDC Loughborough University, pp 15-18.

Piper, C.S. (1950). "Soil and Plant Analysis". Interscience Publisher Inc., New York, USA.

Prasad, R. (1996). Nitrogen use efficiency. Nitrogen Research and Crop Production. Fertilizer Development and Consultation Organization, New Delhi, pp. 104-115.

Radha, M.M.; A. Ravikumar and B. Venkateswarlu (1999). Residual nutrient content of soil as influenced by organics usage in *kharif* rice. Andhra Agric. J. 46(1-2):120-121.

Rasmussen, P.E. and H.P. Collins (1991). Long-term impacts of tillage, fertilizer and crop residue on soil organic matter in temperate semiarid regions. Adv. Agron., 45:93-134.

Rath, A.K.; B. Swain; B. Ramakrishnan; D. Panda; T.K. Adhya; V.R. Rao and N. Sethunathan (1999). Influence of fertilizer management and water regime on methane emission from rice fields. Agric. Ecosyst. Environ., 76(2-3):99-107.

Rhee, H.P.; C.G. Yoon; Y.K. Son and J.H. Jang (2011). Quantitative risk assessment for reclaimed wastewater irrigation on paddy rice field in Korea. Paddy Water Environ., 9(2):183-191.

Richards, L.A. (1954). Diagnosis and improvement of saline and alkaline soils. USDA Agriculture Handbook No. 60, U.S. Government Printing office, Washington DC.

Sarwar, G.; N. Hussain; F. Mujeeb; H. Schmeisky and G. Hassan (2003). Biocompost application for the improvement of soil characteristics and dry matter yield of *Lolium perenne* (Grass). Asian J. Plant Sci., 2(2):237-241.

Selvakumari, G.; M. Baskar; D. Jayanthi and K.K. Mathan (2000). Effect of integration of flyash with fertilizers and organic manures on nutrient availability, yield and nutrient uptake of rice in Alfisols. J. Indian Soc. Soil Sci., 48(2):268-278.

Singh, A. and M. Agrawal (2012). Effects of waste water irrigation on physical and biochemical characteristics of soil and metal partitioning in *Beta vulgaris* L. Agric. Res., 1:379-391.

Stevenson, F.J. (1995). "Humus Chemistry: Genesis, Composition, Reaction", 2^{nd} Ed., John Wiley & Sons, Inc., 111 River St., Hoboken, NJ 07030, USA.

Tayefe, M.; A. Gerayzade; E. Amiri and A.N. Zade (2014). Effect of nitrogen on rice yield, yield components and quality parameters. African J. Biotechnology 13(1):91-105.

Tolanur, S.I. and V.P. Badanur (2003). Effect of integrated use of organic manure, green manure and fertilizer nitrogen on sustaining productivity of *rabi* sorghum-chickpea system and fertility of a Vertisol. J. Indian Soc. Soil Sci., 51(1):41-44.

US EPA (1992). Guidelines for water reuse, EPA No. 625/R-92/004. US Agency International Development. http://www.epa.gov.

van Schouwenburg, J.C. and I. Walinga (1967). The rapid determination of phosphorus in presence of arsenic, silicon and germanium. Anal. Chim. Acta 37:271-274.

Walkley, A. and I.A. Black (1934). An examination of the degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci., 37(1):29-38.

Yadav, R.K.; B. Goyal; R.K. Sharma; S.K. Dubey and P.S. Minhas (2002). Post-irrigation impact of domestic sewage effluent on composition of soils, crops and groundwater - A case study. Environ. Int., 28(6):481-486.

Yagdi, K.; O. Kacar and N. Azkar (2000). Heavy metals concentration in agriculture. Toprakiardeki agir metal Kirligi ye taninsal etikileri ondokuz Mayis Universitasi, Ziraat Fahultasi Dergisi 15(2):109-115.

Yamaguchi, T.; and S. Aso (1977). Studies on chromium from the standpoint of plant nutrition: 1. Effect of chromium concentration on germination and growth of several kinds of plant (rice, wheat, Japanese radishes). (Japanese, translation used). Nippon Dojohiryogaku Zasshi 48(11-12):466-470.

Yanni, Y.G. (1979). Some microbiological and physicochemical studies on waterlogging soils with special reference to the transformation of some soil elements. Ph.D. Thesis, Fac. Agric., Ain Shams Univ., Egypt.

Zhang, W.; D.Y. Han; W.A. Dick; K.R. Davis and H.A.J. Hoitink (1998). Compost and compost water extract-induced systemic acquired resistance in cucumber and arabidopsis. Phytopathology 88(5):450-455.

تأثير نوعية مياه الري والتسميد العضوي علي إنتاجية الأرز

مصطفي محمود منصور[1]، سامي عبد الحميد حماد[1]، أحمد نادر السيد عطية[2]، وأحمد خالد شهاب[1]
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أجريت تجربة حقلية بالمزرعة البحثية لقسم المحاصيل، كلية الزراعة، جامعة المنصورة، المنصورة، مصر لمدة موسم واحد (2014) لدراسة تأثير نوعية مياه الري والتسميد العضوي علي بعض الخواص الكيماوية للتربة وإنتاجية الأرز (صنف 104). صُممت التجربة في شكل شرائح متعامدة في ثلاث مكررات، كانت نوعية مياه الري المستخدمة هي مياه الصرف الصناعي، ومياه الصرف الزراعي، ومياه ري عادية. اشتملت معاملات التسميد العضوي علي السماد البلدي والكمبوست بمعدل 5، و2 طن فدان$^{-1}$ علي التوالي وكانت النباتات التي لم تحصل علي أي معاملات بمثابة كنترول.

أظهرت النتائج نقص معنوي في تفاعل التربة وزيادة معنوية في ملوحة التربة نتيجة استخدام كلا من مياه الصرف الصناعي والزراعي مع معاملات التسميد العضوي. سُجلت أعلي قيمة لتفاعل التربة بواسطة المعاملات I_1T_2 (7.62), I_3T_4 (7.66)، وI_2T_4 (7.35) في مراحل النمو الخضري، وطرد السنابل، والحصاد علي الترتيب. سجلت المعاملات I_1T_4, I_2T_4، و I_1T_2 أعلي قيم لملوحة التربة (جزء/المليون) في مراحل النمو الخضري (522) وطرد السنابل (291) والحصاد (394) علي الترتيب.

بينت النتائج أن استخدام مياه الري العادية مع إضافة السماد البلدي + الكمبوست بالمعدلات الموصي بها سجلت أعلي محصول حبوب (5416 كجم فدان$^{-1}$) يليه المعاملات I_3T_3 (4415), I_2T_4 (4292), I_3T_2 (4195)، وI_3T_1 (4050 كجم فدان$^{-1}$). أيضًا كانت إضافة الكمبوست بمعدل 2 طن فدان$^{-1}$ (T_3) لها الأفضلية علي إضافة السماد البلدي بمعدل 5 طن فدان$^{-1}$ (T_2) في تسجيل أعلي محصول حبوب وقش لنبات الأرز وذلك عند الري باستخدام مياه الصرف الصناعي والزراعي والمياه العادية.