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EFFECT OF ALGAE AND COMPOST EXTRACTS ON SOME SOIL PROPRIETIES AND ITS PRODUCTIVITY UNDER LOW QUALITY IRRIGATION WATER IN NORTH NILE DELTA REGION

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ABSTRACT

Lysimeter experiments were conducted at Sakha Agric. Res. Station Farm, North Delta, during two successive summer growing seasons (2013 and 2014) to study the effect of algae and compost extracts on some soil proprieties and maize yield (*ZEA MAYS L.*) under irrigation by low water quality condition in North Delta. The experiments were designed as split- plot with three replicates. The main plots were occupied by sources of irrigation water as: fresh water (F), drainage water (D), well water (W), blend, F+D (1.15 dS m^{-1} at ratio of 1:1), F+W (2.01 dS m^{-1} at ratio of 1:1), D+W (2.65 dS m^{-1} at ratio of 1:1) and F+D+W (2.0dS m^{-1} at ratio of 1:1:1). Sub plots were devoted to control, compost extract, algae extract and compost + algae extracts .The main results can be summarized as follows: Different irrigation water sources had a significant effect on increasing salinity of the soil after the harvesting of plants during the two growing seasons, compared to fresh water. Salinity of the soil was slightly increased by application of compost extract and /or algae extract and recorded highest values by compost extract + algae extract during the two growing seasons. Alkalinity of the soil was high significantly increased due to irrigation water sources during the two growing seasons. Salinity and alkalinity of the soil was high significantly increased due to the interaction between irrigation water sources and extracts of compost and algae, during the two growing seasons. Soil bulk density high significantly decreased and porosity high significant increased due to irrigation water sources, extracts of compost, algae and due to the interaction between the treatments, during the two growing seasons. Soil available N, P and K were high significantly increased in the combined treatments of compost and algae extracts than those under their sole application and control, during the two growing seasons. Soil available N, P and K was high significantly decreased with increasing the salinity of the irrigation water sources, during the two growing seasons. Consequently the effect of irrigation water types on N- available can be arranged in the following order D > D+W>F+D> F>F+D+E>F+W, W. Irrigation with fresh water (control) gave the highest yield compared to the other irrigation treatments with different levels of saline water, Grain yield was high significantly decreased due to increasing salinity of irrigation water sources during the two growing seasons. The effect of organic application on grain, straw yield and 100 grain weight can be arranged in the following order compost extract + algae extract >algae extract > compost extract >control. Grain, straw and 100gw of maize were high significantly increased due to the interactions effect between irrigation water types and organic application, during the two growing seasons.

- It can be advised to use well and drainage water in irrigation and mix them with Nile fresh water in safe ratios taking into consideration low quality water characteristics and their impact on soil and plant. The addition of some soil conditioners (60 liters of compost extract $Fed.^{-1}$ + 2kgm extract of $algaeFed.^{-1}$), and use a large portion of the drainage water, and agricultural by-products can help as imperative to water deficit and soil improvement consequently, increased food production to face the population growth.

Keywords: Soil properties, low water quality, alga extract, compost, maize yield

INTRODUCTION

Maize (Zea mays L.) is considered as one of the most important cereal crops in Egypt for its wide use in human and livestock feeding and industrial aspects. It ranks the second crop after wheat. Total annual area cultivated with maize varieties was estimated 1.5-2.0 million feddans. Total national production of maize is about 5.43 million tons, while the demand is for at least 7 million tons (El-Atawy and Eid, 2010). This reflects the size of the problem and efforts that needed to increase maize production. This can be achieved by breeding high yielding varieties and through application of improved agro-techniques, using soil and water management. In

Egypt, water was and still the most critical and limited factor in crop production. The Egyptian water budget from the Nile River is 55.5 milliars cubic meter. Under limitation of fresh water resources the farmers will have to use other resources in irrigation in North Delta and we should do our best towards reuse the drainage and well water for irrigation. Maize (*Zea mays L.)* is moderately sensitive to salinity and considered as the most salt-sensitive of the cereals with no yield reduction at ECe of 2 dSm^{-1}, 50 percent at ECe 9 dSm^{-1} and complete loss of yield at 15.3 dSm^{-1} (Maas and Hoffman, 1977). Ayers (1977) concluded that % Grain yield of maize reduction was 0, 10, 25, and 50% due to EC of irrigation water of 1.1, 1.7, 2.5, and 3.9dsm^{-1}, respectively. Irrigation management for safe use of saline water must check excessive salt and sodicity building up. El-Henawy (2000) revealed that soil salinity, SAR and soluble ions increased as a result of using drainage water or drainage water mixed with wastewater under different crops comparison with use fresh water for irrigation. Gaafer et al.(2009) showed that using drainage water (Kafr Dokmiss) in irrigated agriculture land recorded significantly the highest EC, cations and anions concentrations followed by this irrigated with mixed water but this irrigated with Nile water had the lowest values. The addition of mature compost at reasonable rates enhance the plant growth, soil physical properties and also increases available soil nutrient level (Ahmad et al., 2008; Zafar et al., 2011; Amer and El Ramady, 2015).Organic matter is regarded as a very important parameter of soil productivity. It has number of important roles to play in soils, both in their physical structure and as a medium for biological activity. Organic matter makes its greatest contribution to soil productivity. It provides nutrients to the soil, improves its water holding capacity, and helps the soil to maintain good tilth and thereby better aeration for germinating seeds and plant root development (Zia *et al.,* 1993). Soil organic matter encourages granulation, increases cation exchange capacity (CEC) and is responsible for adsorbing power of the soils up to 90 %. Cations such as Ca^{2+}, Mg^{2+} and K^+ are produced during decomposition (Brady, 2005 and Amer *et al.,* 2015). Compost the crop residues and apply in their soils for the increased sustainable crop production, the soil fertility can be improved with a net improvement in land productivity,(Sarwar *et al.,* 2008).FYM reduced the negative impact of saline water on crop parameters including fodder yield. Sole application of saline water reduced the growth and fodder yield of maize cultivars and increased salt contents in soil and caused accumulation of toxic ions (Na^+ and Cl^-) in plant, (Gandahi, 2010).Productive purpose of wheat crop by mean of brackish water (at 20 v/v level) is possible under a level of economical value through its application of algae extracts, (Abd El-Baky et al., 2008). Drainage water must be used for irrigation purposes under controlled with good soil management, use of convenient amendments, good tillage, deep ploughing, organic matter application, land leveling, applying soil and water amendments, and finally suitable cropping system, El-Komy,(2012).In general, the literature review revealed that there are possibly some beneficial effects of organic matter on plant growth and other related parameters. However, there was no clarity as to the extent of these effects. Furthermore, there is no much research carried out on the effects of organic matter treatment under irrigation by blended water on plant growth and soil properties. In this study, therefore, the ameliorative effects of algae and compost extracts on maize yield and some soil properties were investigated under irrigation by low water quality conditions.

MATERIALS AND METHODS

Experimental design

Lysimeter experiments were conducted at Sakha Agric. Res. Station Farm, North Delta, during two successive summer growing seasons (2013 and 2014) to study the effect of algae and compost extracts on maize yield(*ZEA MAYS L*.) under irrigation by low water quality in north delta. The experiments were designed as split- plot with three replicates. The main plots were occupied by water irrigation as: fresh water (F), drainage water (D), well water (W), blend, F+D (1.15 dS m-1 at ratio of 1:1), F+W (2.01 dS m^{-1} at ratio of 1:1), D+W (2.65 dS m-1 at ratio of 1:1) and F+D+W (2.0dS m^{-1} at ratio of 1:1:1). Sub plots were devoted to control (T_1), compost extract: 60Lfed^{-1} (T_2) 30 liters with 1st irrigation and 30liters by 2nd irrigation, algae extract as powder: 2KgFed^{-1} (T_3) with 1st irrigation and T_2+T_3. Maize (single hybrid 10) was planted on 10th and 15th May and harvested on 23rd and 30th September in the first and second growing seasons 2013 and 2014, respectively. All cultural practices for the crop were the same as recommended for the studied area. Algae extract formulation: Start-S obtained from (Salkoiza for agricultural service) company having the following composition: Algae extract (25%), free amino acid (10%) and natural growth regulators (indol putyric acid,0.005).The chemical composition of compost extract: pH, EC(dSm^{-1}), NO^{-}_3, NH_4, P, K, Ca, Mg, Na, Fe, Mn, Zn were 8.11, 5.81, 67.0, 0.73, 21.0, 1.544,463, 240, 58.0, 22.8, 1.18 and 0.93 mgl^{-1} respectively. compost extract contains (*Azospirillium spp.*)

Soil sampling and analysis:

Soil samples were collected at depths (0-20, 20-40 and 40-60 cm) were taken in the initial and after harvesting of maize. The disturbed soil samples were prepared for physical and chemical analysis according to the standard methods. Exchangeable cations Ca, Mg, K and Na, soluble cations and anions as well as soil pH , EC, organic matter and total calcium carbonate were determined according to Page *et al.* (1982). $So^{=4}$ was computed from the difference between sum of the cations and the anions according to Jackson (1958).Sodium adsorption ratio (SAR) estimated by using the following equation, where ionic concentration of the saturation extracts is expressed in meq L^{-1} according to Abdel – Fattah (2012)

$$SAR = \frac{Na}{\sqrt{\frac{ca2+\ +Mg\square +}{2}}}$$

At the same time, undisturbed soil samples were taken to determine the bulk density according to Blake and Hartge (1986), hydraulic conductivity was measured by auger hole method according to Van Beers (1958) as shown in Tables(1&2).The lysimeter unit (82cm diameter x 110 cm depth).

Plant sampling and analysis:

At harvest, plants were taken from all plots to determine grain yield (Mg fed^{-1}), weight of 100 grains (g), stalk yield (Mg fed^{-1}) and N-uptake in both maize grains and stalks were calculated by nitrogen concentration that determined according to Page *et al.,* (1982). Nitrogen use efficiency (Barbar, 1976), was calculated as follows: N use efficiency (NUE) = [(Grain yield from N-fertilizer – grain yield from control) / added N-fertilizer] = Kg grains / Kg N.Some chemical and biological properties of different water sources are in show (Table3).Harvest Index (HI%) was calculated as follows, HI% = (grain yield/grain+ stalk yield)*100

Statistical analyses:

The obtained results were subjected to analyses of variance according to the procedure outlined by Gomez and Gomez (1984), and significant differences were weighted by LSD test at 0.05 level of probability.

Soil pH was determined in soil water suspension (1:2.5), whereas soil EC was determined in saturated soil paste extract, SAR, ESP, CEC, OM and $CaCo_3$represents sodium adsorption ratio, exchangeable sodium percent , cation exchange capacity, organic mater and total calcium carbonate, respectively

Table 1: Chemical soil characterization of the experimental site before cultivation

Depth(cm)	Soil pH	EC ($dS\ m^{-1}$)	SAR (%)	ESP (%)	CEC ($cmole\ kg^{-1}$)	OM ($g\ kg^{-1}$)	$CaCo_3$ %
0 – 20	7.97	3.27	11.9	9.6	41.0	12.4	1.96
20 – 40	7.98	3.48	12.1	9.7	41.3	12.1	1.92
40 – 60	8.01	3.58	12.0	9.8	41.5	10.1	1.91
Mean	7.99	3.44	12.0	9.7	41.27	11.53	1.93

Table 2: Physical soil characterization of the experimental site before cultivation

Soil depth(cm)	Soil moisture characteristics				Particle size distribution (%)			
	Field Capacity (%)	WP (%)	AW (%)	BD ($kg\ m^{-3}$)	Sand	Silt	Clay	Soil texture
0 – 20	41.3	22.1	19.2	1.39	17.7	31.3	50.0	Clayey
20 – 40	41.5	21.8	19.7	1.40	16.92	31.98	51.1	Clayey
40 – 60	38.6	20.4	18.2	1.41	17.62	31.78	50.6	Clayey

WP, AW, and BD represents, welting point, available water and bulk density, respectively

Table 3: Some chemical and biological properties of the different water source

Water sources	PH	EC($dS\ m^{-1}$)	SAR	$Na^+ mql^{-1}$	Cl^- mql^{-1}	So^-4 mql^{-1}	COD Mgl^{-1}	BOD Mgl^{-1}	NH4(N) Mgl^{-1}	NO^3(N) Mgl^{-1}	Suspended solids Mgl^{-1}	Dissolved solids Mgl^{-1}
Fresh water (F)	7.1	0.51	1.46	2.02	3.6	0.1	14	8.5	1.26	4.8	234	461
Drainage water (D)	8.40	1.65	5.92	10.3	11.6	1.0	45	24	12	28	401	1541
W ill water (W)	8.1	3.12	10.1	21.5	17.2	9.2	0.0	0.0	2.1	3.8	26	3001
F+D:(1:1)	7.31	1.15	3.65	5.9	4.1	0.4	38	14.5	9.1	19	251	751
F+W :(1:1)	7.41	2.01	7.12	13.1	4.5	6.4	24	9.0	1.78	4.5	221	2410
D+W :(1:1)	8.12	2.65	8.2	17.0	13.6	8.1	41	10.0	5.4	15.2	210	1580
F+D+W :(1:1:1)	7.75	2.0	7.0	13.0	9.1	5.9	25	10.0	2.8	5.5	168	1351

RESULTS AND DISCUSSION

1. Soil chemical properties:

Some soil chemical characteristics of experimental soil as influenced by low quality water irrigation, algae and compost extracts under growing maize crop are illustrated in Tables 4 and 5.

Soil salinity (ECe):

Irrigation water had a high significant effect on increasing salinity of the soil after the harvesting of plants during the two growing seasons as shown in Table (4). Data show that the mean values of ECe were increased by about 9.08, 28.09,13.62, 17.45,21.28 and 17.82% with irrigation by drainage water (D), well water (W), F+D, F+W, D+W and F+D+W, respectively as compared by irrigation with fresh water. Consequently the effect of irrigation water types on soil salinity can be arranged in the following order W> D+W > F+D+W> F+W > F+D >D. It can be said that soil EC_e values increased as the EC_w of irrigation water increased (Table 4and 5) . Increasing the soil salinity may be due to soluble cations and anions were in drainage and well water. Upon reuse of drainage water in irrigating of soils in the terminal end resulted in a remarkable increase in soil salinity and sodicity as compared to soil irrigated with Nile water. Data in Table (4 and5) reveal that, salinity of the soil was no significant increased by application of compost extract and /or algae extract during the two growing seasons. organic materials improve the soil physicochemical properties that accelerate exchange of cations on soil solids and leaching of salts from the root zone Similar results were found by Gendy(2005),Clark *et al.* (2007) and El-Hadidi *et al.*(2008)

Soil alkalinity (SAR and ESP):

Data listed in Table (4) indicate that alkalinity of the soil was high significant increased due to irrigation of low quality water sources during the two growing seasons. Data show that the mean values of SAR were increased by about 20.8, 30.9,23.2, 25.3,28.0 and 25.6% with water using drainage water (D), well water (W), F+D, F+W, D+W and F+D+W, respectively as compared by irrigation with fresh water, Table (5). Consequently the effect of irrigation water types on SAR values can be arranged in the following order W > D+W > F+D+W> F+W > F+D > D. Also, data show that ESP was increased by about 24.4, 34.2, 26.8, 29.0, 31.2 and 24.8% with irrigation by drainage water (D), well water (W), F+D, F+W, D+W and F+D+W, respectively as compared with irrigation by fresh water.

Sodium adsorption ratio (SAR) of the soil was no significant increased by application of compost extract and /or algae extract during the two growing seasons. Alkalinity of the soil (ESP %) was significant decreased due to compost and algae extracts application. Salinity and alkalinity of the soil was slightly decreased due to the interaction between irrigation water type and extracts of compost and algae, compared to the other treatments during the two growing seasons. However, the improvements in the soil chemical characteristics of plots amended with compost and algae extract when compared with plots without organic application were more pronounced. The results may be due to increased Ca^{2+} concentration in soil solution, Na^+ – Ca^{2+} exchange at the soil's cation exchange sites, leaching of the exchanged Na^+ in percolating water and subsequent reduction in soil sodicity These results are in the same line with those obtained by Qadir, and Oster (2004) and Amer *et al.,* (2015).

Table4.Some chemical characteristics of the soil after harvesting of maize as affected by low quality irrigation water, alga and compost extracts (both seasons)

Treatments		1st season			2nd season		
		EC(dSm^{-1})	SAR (%)	ESP (%)	EC(dSm^{-1})	SAR (%)	ESP (%)
Main treatments (T)	Fresh water (F)	3.51g	8.03g	9.0g	3.54f	7.99g	9.5f
	Drainage water (D)	3.83f	9.66f	11.48f	3.86e	9.7e	11.54e
	Well water (W)	4.45a	10.41a	12.32a	4.58a	10.56a	12.51a
	F+D: (1:1)	3.93e	9.78e	11.63e	4.08d	9.96e	11.83d
	F+W: (1:1)	4.10d	9.99d	11.88d	4.18c	10.09c	11.99c
	D+W: (1:1)	4.23b	10.15b	12.08	4.32b	10.35b	12.19b
	F+D+W: (1:1:1)	4.13c	10.03c	11.1c	4.176c	10.09c	11.99c
	F_{test}	**	**	**	**	**	**
	$LSD_{0.05}$	0.01	0.01	0.02	0.01	0.02	0.02
Sub-main treatments (M)	Control (T1)	4.02	9.69	12.0a	4.0	9.77	12.1a
	Compost extract (T2)	4.02	9.71	11.65b	4.03	9.80	11.65b
	Algae extract (T3)	4.02	9.72	11.60c	4.04	9.81	11.5c
	T2+T3	4.03	9.73	11.10d	4.04	9.83	11.3d
	F_{test}	ns	ns	*	ns	ns	*
	$LSD_{0.05}$			0.11			0.11
Interaction: T x M		*	**	*	*	**	*

Table5.Mean of relative change (± %) of some soil characteristics after harvesting of maize as affected by different treatment (mean of both seasons)

Treatments		EC(dSm^{-1})	SAR (%)	ESP (%)
Main treatments (T)	Fresh water (F)	3.53	8.01	9.25
	Drainage water (D)	+9.08	+20.8	+24.4
	Well water (W)	+28.09	+30.9	+34.2
	F+D	+13.62	+23.2	+26.8
	F+W	+17.45	+25.3	+29.0
	D+W	+21.28	+28.0	+31.2
	F+D+W	+17.82	+25.6	+24.8
Sub-main treatments (M)	Control (T1)	4.04	9.73	12.05
	Compost extract (T2)	0.0	+0.3	-3.3
	Algae extract (T3)	+0.12	+0.4	-4.1
	T2+T3	+0.24	+0.5	-7.1

2 Soil physical properties:

- Soil bulk density and its porosity:

Data in Table (6) show that the soil bulk density was high significantly decreased, however soil porosity was high significant increased due to irrigation water sources during the two growing seasons. Data show that application of compost and algae extracts separate or mixed high significantly increased the soil porosity and decreased soil bulk density during the two growing seasons. It can be attributed to the increase in soil aggregation due to the addition of organic extracts. These findings are in some harmony with those obtained by He et al., (1995) Soil bulk density and porosity high significantly affected due the interaction between irrigation water and organic application. Well and drainage water irrigation sources high in sodium (Na) may lead to the deterioration of soil structure. High soil Na causes soil clays and organic matter to disperse or deflocculated. The clays and organic matter clog soil pores, reducing water infiltration and soil aeration. However application of organic extracts that attract calcium and magnesium cause the soil to flocculate, and therefore counteract the negative effects of Na.

In general, the benefits of organic ameliorator on improving soil health by enhancing soil quality parameters: physical (soil porosity, aggregation, structure, bulk density, and water holding capacity), The obtained results are similar to those reported (Ahmad *et al.,* 2008; Zafar *et al.,* 2011 and Amer *et al.,* 2015)

Table (6):Some physical characteristics of the soil after harvesting of maize as affected by treatments during two growing seasons

Treatments		1st season		2nd season	
		BD (Mg m-3)	Porosity (%)	BD (Mg m-3)	Porosity (%)
Main treatments (T)	Fresh water (F)	1.440a	46.58e	1.44a	46.6e
	Drainage water (D)	1.413b	47.54b	1.41c	47.55b
	Well water (W)	1.40f	46.53e	1.40e	46.53f
	F+D: (1:1)	1.413b	46.57e	1.415b	46.57fe
	F+W: (1:1)	1.403e	47.08d	1.405d	47.13d
	D+W: (1:1)	1.405d	47.36c	1.405d	47.39c
	F+D+W: (1:1:1)	1.41c	48.70a	1.415b	48.77a
	F_{test}	**	**	**	**
	$LSD_{0.05}$	0.0005	0.076	0.0039	0.055
Sub-main treatments (M)	Control (T1)	1.424a	46.03d	1.43a	46.03d
	Compost extract (T2)	1.413b	46.63c	1.42c	46.65c
	Alga extract (T3)	1.407c	47.47b	1.41c	47.47b
	T2+T3	1.40d	48.58a	1.40d	48.72a
	F_{test}	**	**	**	**
	$LSD_{0.05}$	0.005	0.060	0.0053	0.04
Interaction: T x M		**	**	**	**

-Available-macronutrients

Soil available N, P and K was high significantly decreased by increasing the salinity of the irrigation water sources, during the two growing seasons as shown in Table 7, the lowest values of N-available was obtained as a result of treated soil with fresh + well and well irrigation water. However the highest values were obtained by irrigation with drainage water that contain some organic materials and nitrogen, during the two growing seasons. Consequently the effect of irrigation water sources on N-available can be arranged in the following order D > D+W> F+D> F>F+D+E>F+W,W.

With regard to available- P, data indicate that the highest values was obtained by irrigation with (F+D) water. However the effect of irrigation water sources on available -P can be arranged in the following order F+D>D> F+D+W> F> D+W> F+W> W. Concerning available - K, data indicate that the highest values were obtained by irrigation of water F+D. However the effect of irrigation water sources on available - k can be arranged in the following order F+D> F> F+D+W> D > W> D+W> F+W

Data in Table 7 show the increasing in available-macronutrients as a result of treating soil with organic application, during the two growing seasons. Soil available N, P and K were high significantly increased in the combined treatments of compost and algae extracts than those under their individual application and control, during the two growing seasons, as show in Table (7). K is found in available form; when the acid or acids forming compounds are added in the form of compost to the soil, these affect potassium availability. The effect is positive resulting in more availability of K to the plants. The hydrogen ions released from organic materials are exchanged with K on exchange site or set free from the fixed site of the clay micelle. Thus, the overall status of soil regarding availability of potassium content is improved. The obtained results are similar to those reported (Ahmad *et al.,* 2008; Zafar *et al.,* 2011, Amer and El-Ramady 2015)

Table 7. Effect of irrigation low quality water and some soil conditioners on available macronutrients (mg kg^{-1} soil) in soil after maize harvesting for both two seasons.

Treatments		1st season			2nd season		
		N	P	K	N	P	K
Main treatments (T)	Fresh water (F)	31.58d	9.95d	319.0b	31.61de	10.13c	319.5b
	Drainage water (D)	34.05a	10.10b	317.08d	33.85a	10.27a	318.2c
	Well water (W)	31.33f	9.24g	314.75e	31.48ef	9.34g	315.5e
	F+D :(1:1)	32.77c	10.18a	319.75a	32.85c	10.19b	320.3a
	F+W:(1:1)	31.33f	9.58f	312.66g	31.46f	9.70f	313.0g
	D+W:(1:1)	33.22b	9.73e	313.16f	33.28b	9.83e	313.5f
	F+D+W:(1:1:1)	31.45e	10.05c	317.66c	31.75d	10.10d	318.0d
	F_{test}	**	**	**	**	**	**
	LSD 0.05	0.119	0.046	0.36	0.145	0.017	0.168
Sub-main treatments (M)	Control	30.28d	8.73d	307.0c	30.35d	8.90d	307.43d
	Compost extract	31.99c	10.20b	318.48b	33.09a	10.25b	319.43b
	Algae extract	32.92b	10.00c	318.43b	32.20c	10.07c	318.80c
	T2+T3	33.80a	10.38a	321.29a	33.67a	10.52a	321.76a
	F_{test}	**	**	**	**	**	**
	$LSD_{0.05}$	0.098	0.035	0.17	0.097	0.012	0.087
Interaction: T x M		**	**	**	**	**	**

Yield of Maize:

In fact, direct use of drainage water for irrigation with salinity varying from 2 to 3 dS/m, is common in the districts of Northern Delta where there are no other alternatives or in areas of limited better water quality supply. Farmers in Beheira, Kafr-El-Sheikh, Damietta and Dakhlia Governorates have successfully used drainage water directly for periods of 25 years to irrigate over 10 000 ha of land, using traditional farming practices. The soil texture ranges from sand, silt loam to clay with calcium carbonate content of 2 to 20 percent and very low in organic matter. The major crops include clover, rice, Maize, wheat, barley, sugar beet and cotton. Yield reductions of 25 to 30 percent are apparently acceptable to local farmers. Yield reductions observed are attributed to water logging and salinization resulting from over-irrigation and other forms of poor agricultural, soil and water management. FAO,(1992)

The results of this study show that, irrigation with fresh water (control) gave the highest yield compared to irrigation with different levels of saline water, grain yield and harvest index of maize was high significant decreased due to increased salinity of irrigation water sources during the two growing seasons as shown in Table 8. The lowest values of grain yield (2.9 and 3.04MgFed.$^{-1}$) were obtained as a result of irrigation with well water. These results are in agreement with those obtained by Ayers, (1977) and FAO, (1992). On the other hand the highest values (4.63 and 4.86 MgFed.$^{-1}$) were obtained due to irrigation by fresh water for 1st and 2nd two seasons, respectively. The same trends of straw yield (3.49 and 3.63MgFed.-1) were obtained as result of irrigation with well water. While the highest values (6.29 and 6.53 MgFed.$^{-1}$) were obtained by irrigation with fresh water, 1st and 2nd seasons, respectively. With regard to the effect of irrigation water on 100 grain weight, data show that the lowest values of 100gw (34.8 and 35.8g) were obtained with well water. Where the highest values (48.1 and 49.6 g) were recorded with irrigation by fresh water for 1st and 2nd seasons, respectively. Consequently the effect of irrigation water sources on grain, straw yield and 100 grain weight can be arranged in the following order F > F+D> D> F+W> F+D+W> D+W> W. The obtained results are similar to that reported Flávio *et.al,* (2008) reported that grain yield of the corn was reduced by 20% for each unit increase in electrical conductivity of the irrigation water and of the soil solution above 1.7 and 4.6 dS m^{-1}, respectively. The growth of corn was reduced with increasing of salinity.

Data in Tables 8 and 9 declares a noticeable increasing in grain, straw yields of maize as a result of treating soil with organic extracts, as compared with control during the two growing seasons. Grain, straw, 100gw and harvest index of maize were high significantly increased in the combined treatments of compost and algae extracts than those under their individual application and control, during the two growing seasons, as show in Table(8). Consequently the effect of organic application on grain, straw yield, and 100 grain weight and harvest index can be arranged in the following order compost and algae extracts > alga extract > compost extract > control. The obtained results are similar to those reported by Ahmad *et al.,* (2008) and Zafar et al., (2011).Grain, straw, and 100gw and harvest index of maize were high significantly increased due to the interactions effect between irrigation water sources and organic application, during the two growing seasons. The improvement of maize yield may be due to the role of humic substances in plant nutrition, osmoregulation and mitigating the adverse effects of high salt concentrations in soils. The obtained results are similar to those reported by Abd El-Baky *et al.* (2008); Amer *et al.,* (2015) and Amer and El-Ramady (2015).

Table8. Mean grain and straw yield of maize ($MgFed.^{-1}$),100 grain weight (g) and harvest index (%) as affected by low quality irrigation , algae and compost extracts (both seasons)

Treatments		1st season				2nd season			
		Grain ($MgFed.^{-1}$)	Straw ($MgFed.^{-1}$)	100gw (g)	HI (%)	Grain ($MgFed.^{-1}$)	Straw ($MgFed.^{-1}$)	100gw (g)	HI (%)
Main treatments (T)	Fresh water (F)	4.63a	6.29a	48.1a	42.4b	4.86a	6.53a	49.6a	42.67b
	Drainage water (D)	3.70c	5.19c	45.4c	41.62e	3.88c	5.39c	46.8c	41.86e
	Well water (W)	2.90g	3.49g	34.8g	45.4a	3.04g	3.63g	35.8g	45.58a
	F+D (1:1)	3.98b	5.46b	46.4b	42.16c	4.18b	5.68b	47.8b	42.39c
	F+W (1:1)	3.48e	4.85e	40.5e	41.78d	3.65e	5.04e	41.8e	42.0d
	D+W (1:1)	3.33f	4.77f	39.3f	41.11g	3.51f	4.96f	40.5f	41.44g
	F+D+W (1:1:1)	3.62d	5.11d	44.0d	41.47f	3.80d	5.31d	45.4d	41.71f
	Ftest	**	**	**	**	**	**	**	**
	LSD 0.05	0.022	0.005	0.01	0.12	0.015	0.005	0.02	0.122
Sub-main treatments (M)	Control (T1)	3.10d	4.78d	41.4d	39.34d	3.26d	4.97d	42.7d	39.61d
	Compost extract (T2)	3.45c	4.93c	42.5c	41.17c	3.62c	5.13c	43.8c	41.37c
	Algae extract (T3)	3.60b	5.14b	42.8b	41.19b	3.79b	5.35b	44.1b	43.47b
	T2+T3	4.49a	5.24a	43.9a	46.15a	4.72a	5.50a	45.3a	46.18a
	Ftest	**	**	**	**	**	**	**	**
	LSD 0.05	0.013	0.003	0.01	0.05	0.007	0.003	0.02	0.052
Interaction: T x M		**	**	**	**	**	**	**	**

Table9. Mean of relative change (± %) of grain, straw yield of maize ($MgFed.^{-1}$), 100 grain weight (g) and harvest index (%) as affected by low quality irrigation , algae and compost extracts application (for both seasons)

Treatments		**Grain**	**Straw**	**100gw**	**HI**
Main treatments (T)	**Fresh water (F)**	**4.63 MgFed.-1**	**6.29 MgFed.-1**	48.1(g)	42.1(%)
	Drainage water (D)	-20.1	-17.5	-5.6	-1.8
	Will water (W)	-37.4	-44.5	-27.7	7.8
	F+D (1:1)	-14.0	-13.1	-3.6	-0.5
	F+W (1:1)	-24.9	-22.9	-15.8	-1.4
	D+W (1:1)	-27.9	-24.1	-18.3	-2.8
	F+D+W (1:1:1)	-21.8	-18.7	-8.5	-2.1
Sub-main treatments (M)	Control (T1)	3.10	4.78	41.4	39.6
	Compost extract (T2)	+11.2	+3.2	+2.6	+4.0
	Algae extract (T3)	+16.2	+7.6	+3.3	+4.3
	T2+T3	+44.8	+10.2	+6.1	+16.5

Nutrients states

Data in Table (10) show that, irrigation with fresh water (control) gave the highest values of nutrients uptake by maize (kgFed.$^{-1}$) as compared to the different levels of saline water irrigation. Nutrients uptake was high significantly decreased due to increasing salinity of irrigation water during the two growing seasons as shown in Table 10. The lowest values of N-uptake (79.7 and 83.4 KgFed.$^{-1}$) were obtained as a result of irrigated the soil with well irrigation water for 1st and 2nd seasons, respectively. However the highest values (143.5 and 150.3 KgFed.$^{-1}$) were obtained by irrigation with fresh water for 1st and 2nd seasons, respectively. The data show that the lowest values of P-uptake (13.73 and 14.5 KgFed.$^{-1}$) were obtained as a result of well water irrigation. However the highest values (25.11 and 26.3 KgFed.$^{-1}$) was obtained by irrigation with fresh water, for 1st and 2nd seasons, respectively. With regard to the effect of irrigation water on K-uptake, data show that the lowest values of K-uptake (80.9 and 80.4 KgFed.$^{-1}$) were obtained with well water irrigation. The highest values (146.5 and 152.3 KgFed.$^{-1}$) were resulted with irrigation by fresh water for 1st and 2nd seasons, respectively. Consequently the effect of irrigation water sources on N, P and K uptake of maize yield can be arranged in the following order F > F+D> D> F+W> F+D+W> D+W> W**.**

Data in Table 10 declare a noticeable increasing in uptake of maize as a result of organic extracts application, as compared with control during the two growing seasons. uptake of maize was high significantly increased in the combined treatments of compost and algae extracts than those under their sole application and control, during the two growing seasons, as shown in Table (10). Consequently the effect of organic application on uptake can be arranged in the following order compost and alga extracts > alga extract > compost extract > control. uptake of maize were high significantly increased due to the interactions effect between irrigation water sources and organic application, during the two growing seasons. Addition of humic substances (compost and alga extracts) enhance the uptake of minerals through the stimulation of microbiological activity. The obtained results are similar to those reported by Zafar *et al.,* (2011) ; Amer *et al.,* (2015) and Amer and El-Ramady (2015).

Table10.Effect of irrigation by low quality water, compost and algae extracts on nutrients uptake by (grains +stalk) of maize(kgFed.$^{-1}$) during both seasons

Treatments		1st season			2nd season		
		N	P	K	N	P	K
Main treatments (T)	Fresh water (F)	143.5a	25.11a	146.5a	150.3a	26.3a	152.3a
	Drainage water (D)	115.6c	19.61c	118.6c	120.8c	20.6c	123.7c
	Well water (W)	79.7g	13.73g	80.9g	83.4g	14.5g	84.4g
	F+D: (1:1)	123.3b	21.09b	125.7b	128.7b	22.2b	131.1b
	F+W:(1:1)	107.5e	17.84e	110.7e	112.5e	18.8e	115.4e
	D+W:(1:1)	101.9f	17.34f	108.2f	106.7f	18.3f	112.9f
	F+D+W:(1:1:1)	112.9d	18.73d	116.6d	117.9d	19.7d	121.5d
	F_{test}	**	**	**	**	**	**
	LSD $_{0.05}$	0.22	0.08	0.1	0.11	0.09	0.12
Sub-main treatments (M)	Control	87.6d	14.63d	105.1d	91.6d	15.8d	109.9d
	Compost extract	110.7c	18.34c	112.6c	115.7c	19.2c	117.3c
	Algae extract	116.7b	19.71b	118.2b	121.9b	20.6b	123.1b
	T2+T3	133.3a	23.57a	125.4a	134.5a	24.7a	130.6a
	F_{test}	**	**	**	**	**	**
	LSD $_{0.05}$	0.102	0.05	0.06	0.11	0.05	0.06
Interaction: T x M		**	**	**	**	**	**

Nitrogen use efficiency (NUE) of maize yield

Nitrogen use efficiency was high significantly decreased with increasing salinity of irrigation water during the two growing seasons as shown in Table 11. The highest and lowest values of NUE were obtained as a result of irrigation with fresh water and well water.

Table 11.Nitrogen use efficiency (NUE) of maize yield (kg grain/kg N-applied) during the two growing seasons

Treatments		1st season	2nd season	Mean
Main treatments (T)	**Fresh water (F)**	38.6a	40.5a	39.5
	Drainage water (D)	30.8c	32.3c	31.6
	Well water (W)	24.2g	25.3g	24.8
	F+D:(1:1)	33.2b	34.8b	34.0
	F+W:(1:1)	29.0e	30.4e	29.7
	D+W:(1:1)	27.8f	29.3f	28.5
	F+D+W:(1:1:1)	30.2d	31.7d	30.9
	Ftest	**	**	
	LSD 0.05	0.15	0.14	
Sub-main treatments (M)	Control (T1)	25.8d	27.2d	26.5
	Compost extract (T2)	28.8c	30.2c	29.5
	Algae extract (T3)	30.0b	31.6b	30.8
	T2+T3	37.4a	39.3a	38.4
	Ft_{est}	**	**	
	LSD 0.05	0.16	0.15	
Interaction: T x M		**	**	

Consequently the effect of irrigation water sources on NUE can be arranged in the following order: F > F+D >D>F+W+D >F+W> D+W >W. NUE was high significantly increased due to organic application however the highest value was recorded by compost and algae extracts during the two growing seasons. Consequently the effect of organic application on NUE can be arranged in the following order: com post and alga extracts > alga extract > compost extract > control. NUE of maize were high significantly increased due to the interactions effect between irrigation water sources and organic application, during the two growing seasons. Increasing of NUE by addition of humic substances (compost and alga extracts) may be to enhance the uptake of minerals and dry weight of maize and reduced the negative impact of saline water .On the other hand NUE was decreased due to irrigation by saline water. The obtained results are similar to those reported by FAO, (1992) and Amer and El-Ramady (2015).

CONCLUSION

In order to face water deficit in Egypt, the strategy is blending or diluting low quality waters with fresh waters, spite of the problems of low quality water effect under certain conditions.

It could be recommended that the addition of some organic conditioners, such as compost and algae extracts could be mitigate the harmful effects of using such water on soil and crop production.

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تاثير اضافة مستخلص الكمبوست والطحالب على بعض خواص وانتاجية التربه تحت ظروف الرى بمياه منخفضة الجودة فى شمال دلتا النيل

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أجريت تجربتان فى ليزيميترات قسم بحوث وتحسين الاراضى بمحطة البحوث الزراعية بسخا محافظة كفرالشيخ وذلك خلال موسمين نمو صيفين متتاليين ٢٠١٣ و ٢٠١٤، لدراسة تأثير اضافة مستخلص الكمبوست والطحالب على خواص وانتاجية التربة تحت ظروف الرى بمياة منخفضة الجودة. صممت التجارب كقطع منشقة مره واحدة فى ثلاث مكررات خلال موسمي الدراسة حيث كانت المعاملات الرئيسية معاملات الرى: ماء عذب، ماء صرف، ماء بئر،ماء عذب + ماء صرف (١:١) ،ماء عذب + ماء بئر(١:١) ، ماء بئر + ماء صرف(١:١) ،ماء عذب + ماء بئر + ماء صرف (١:١:١)، والمعاملات الشقية هى بدون معاملة (كنترول)، مستخلص الكمبوست بمعدل ٦٠ لتر/فدان، مستخلص الطحالب ٢كجم /فدان، مستخلص الكمبوست+مستخلص الطحالب ويمكن تلخيص النتائج المتحصل عليها فيما يلى:

تبين من النتائج زيادة معنوية لملوحة التربة بعد حصاد الذرة خلال موسمى الدراسة تحت ظروف الرى بمياه منخفضة الجودة وخاصة عند الرى بمياه البئر ثم مياه الصرف او الخلط بينهم ، ومن ناحية اخرى لوحظ زيادة غير معنويه لملوحة التربة مع اضافة كل من مستخلص الكمبوست والطحالب او المزج بينهم.

توضح النتائج زيادة معنويه لقلويه التربة نتيجه معاملات الرى بمياة البئر و الصرف بينما تقل هذه الزيادة مع الخلط بين مصادر مياه الرى، كما لوحظ تحسن معنوى لخواص التربة الكيميائية مع اضافة المحسنات العضوية تحت ظروف الرى المختلفة.

لوحظ تناقص معنوى للكثافة الظاهرية للتربة مع زياده المسامية نتيجه معاملات الرى ،واضافة المحسنات العضوية و كذلك التفاعل بين المعاملات خلال موسمى الدراسة.

تشير النتائج الى تناقص معنوى لحالة العناصر الميسرة مثل النيتروجين والفوسفور والبوتاسيوم مع زياده مستوى ملوحة مياة الرى ، بينما لوحظ زيادة معنوية لحالة العناصر الميسرة فى التربة نتيجة اضافة كل من مستخلص الكمبوست والطحالب وبلغت اعلى زيادة مع الجمع بينهما تحت ظروف الرى بمياة منخفضة الجودة،ويمكن توضيح تاثير الرى بمياة منخفضة الجودة على محتوى التربة من النيتروجين الميسر فى هذه المتسلسلة:ماء بئر< ماء بئر + ماء عذب<عذب +بئر +صرف<عذب<عذب +صرف<بئر+صرف

تبين النتائج زيادة معنويه لمحصول الذرة ووزن مائة حبة مع اضافه مستخلص الكمبوست والطحالب وبلغت اقصاها مع المزج بينهم،ومن ناحيه اخرى يتناقص المحصول تناقص معنوى مع زيادة ملوحة مياة الرى،بينما يقل هذا التناقص مع اضافة خليط من مستخلص الكمبوست والطحالب تحت ظروف معاملات الرى.

لوحظ تناقص كفاءة استخدام النيتروجين مع زيادة ملوحه مياة الرى،بينما يقل هذا التناقص مع اضافة اضافة خليط من مستخلص الكمبوست والطحالب تحت ظروف معاملات الرى خلال موسمى الدراسة.

الخلاصة:

- عند استخدام مياه الابار ومياة الصرف الزراعى فى الرى او المخلوطة مع مياة النيل العذبة بنسب معينة يجب مراعاه خواص مياه الصرف ومدى تاثيرها على التربه والنبات مع اضافه ارضيه لبعض المحسنات (٦٠لتر مستخلص كمبوست/ فدان+ ٢كجم مستخلص طحالب /فدان) ، وبالتالى يمكن استخدام جزء كبير من مياه الصرف الزراعى ،والمخلفات الزراعية كضروره حتمية لسد العجز المائى وتحسين التربة وزياده انتاج الغذاء لمواجهه الزيادة السكانية.ذ