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EFFECT OF COMPOST, COMPOST TEA AND BIO-FERTILIZER APPLICATION ON SOME CHEMICAL SOIL PROPERTIES AND RICE PRODUCTIVITY UNDER SALINE SOIL CONDITION.

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ABSTRACT

Two field experiments were conducted at El-Rowad village , Sahl- El-Hossinia , El-Sharkia Governorate, Egypt, during summer2007 and 2008 seasons to study the effect of bio-fertilizer, compost and compost tea or in combination with nitrogen levels (25 , 50 and 100 kg N/fed). The compost is prepared from (rice straw, Maize and faba bean); Compost tea is prepared as a water extract of plant soluble nutrients, while the bio-fertilizer was a strain of *Azospirillum braselence* NO 40 (salt tolerant PGPR strain). The compost was applied before rice planting, and bio-fertilizer was applied seed coating while compost tea was sprayed after 25- 50- and 75days from rice planting.

The obtained results could be summarized as follows:

Application of compost, compost tea and bio-fertilizer combined with different levels of nitrogen mineral fertilizer led to increase significantly yield, weight of straw or grain (g) /plant, weight of 1000= grains (g) and yield index. The macronutrients N, P and K contents in rice straw and grains increased significantly with the application of compost, compost tea and bio-fertilizer in combination with different levels of N-mineral fertilizer, especially with the high levels as compared with N- mineral fertilizer levels applied alone. The combination of compost and /or compost tea and bio-fertilizer in addition to N- mineral levels enhanced the micronutrients (Fe, Mn, and Zn and Cu mg/kg) concentrations in rice straw and grains in both seasons. The effect of bio-fertilizer and other organic materials were due to lowering soil pH. Meanwhile, EC of the studied saline soil decreased due to the leaching of salts as a result of improving soil physical conditions. The amount of all soil available nutrients N, P and K (mg/kg soil) increased in the soil. Therefore Available Micronutrients Fe, Mn, Zn and Cu (mg/kg soil) also increased when compost, compost tea and bio-fertilizer were combined with different mineral N- fertilizer levels.

Keywords: compost-compost tea- bio-fertilizer – saline soil- rice crop.

INTRODUCTION

Egypt has a total area of about one million square kilometer. Egypt is situated in the arid and semi arid zones belt characterized by limited arable land resources, whether irrigated, alluvial agricultural land, natural grazing meadows or wetlands. Currently irrigated and cultivated land in Egypt is about 7.95 million feddans, from which 5.3 million feddans are fertile sedimentary lands in the Delta and the Valley, while the remaining land is desert, reclaimed during the last five decades. Egypt's population has reached 67.5 million, while the total area cultivated is 7.95 million feddans. According to the latest Central Authority for Public Mobilization and Statistics (CAPMAS) (2002). According to FAO (2004), Egypt is the largest rice producer in the Near East region. Rice (genus *Oryza*) is tolerant to desert, hot, humid, flooded, dry and cool conditions, and grows in saline, alkaline and acidic soils. .Most of the planted rice varieties are *japonica*. High solar radiation, the long days and the cool nights between May and September are favorable to a high rice yield. In fact, the Egyptian rice yield is one of the highest in the world (9.1 tones per hectare in 2001). Because of limited water resources, the government of Egypt has tried to limit rice cultivation, but cultivation has continued to expand due to rice high profits, and Egypt is today a major rice exporter.

Compost is a method utilized for the reduction, recycling, and re-utilization of crop residues (Bernal *et al.*., 1998). Epstein (1997) stated that the application of compost to soil favorably affects water holding capacity, erosion control, cation exchange capacity, pH, macro elements availability, and soil structure, porosity and aeration. Large quantities of compost applied during several years are needed to observe changes in soil characteristics. Rebeka (2006) reported that most chemical parameters of the compost extracts generally reflect the chemical composition of the starting materials. In facts, compost fertilizer extracts show in average a lower pH, lower salinity (ECe, for lower dilutions), and K concentration but a relatively higher N, P, Ca and Mg concentrations were for compost as a source of nutrients for plant growth. Evaluating the quantities of nutrients in the compost may help determine if this product meets the requirements of agronomic crops. In general, and because of the decomposition that organic wastes undergo in the composting process, there is a limited quantity of macro and micronutrients in the compost. Claudio *et al..* (2007) found that the pH increment depends on the soil and the compost characters as well as on the dose and time of application. Increasing the period between compost application and the plantation to 30 days resulted in low soil pH values. Aly *et al..* (1999) found highly significant increases in growth, grain yield and yield components of wheat due to the inoculation of crop seeds with symbiotic N_2-Fixing bacteria. Hussein and Radwan (2001) reported that increasing N – fertilizer rates led to significant increases in N and P contents in grains. Soh (2001) found that urea is preferable to nitrate for growing rice in flooded soils, and thus the Far East and the Middle-East are major consumers of urea. El-Sheref *et al..* (2004) found that grain yield and nitrogen content of rice crop increased significantly with increasing nitrogen dose. Tiwari *et al..* (2000) recorded a significant increase in grain yield of rice at different applied levels of N-fertilizer.

Compost tea can improve soil quality by increasing the number of beneficial soil organisms. Plants depend on soil microorganisms for gathering and incorporating nutrients in their roots. Compost tea contains substantial quantities of them, which are released into the soil when the compost tea is added around plants. Compost tea, in modern terminology, is a compost extract brewed with a microbial food source like: molasses, kelp, rock dust, humic - fulvic acids. The compost-tea brewing technique, (an aerobic process usually under forced aeration) extracts and grows population of microbial community (Mukhtar *et al.*., 2004). Lobna *et al..* (2006) showed that the compost tea is a watery extract of plant soluble nutrients and microorganisms from compost. The organisms include bacteria, fungi, protozoa and nematodes. When applied to plant surfaces and drench into the rooting zone, it can protect the plant from diseases and enhance its growth. Crops can directly benefit from the macro-and micronutrients found in compost tea. Foliar fertilization with compost tea allows nutrients to be absorbed by the plants directly through stomata on their leaf surfaces. Compost tea can also provide nutrients to the soil through soil drenches.

The present study aims to study the effect of compost, compost tea and bio-fertilizer and/ or their combination with different nitrogen levels on some soil chemical properties, growth, yield and its components and grain protein content of rice (cv. Giza 187) grown on newly reclaimed saline soils as well as, to investigate if the use of these treatments would help to reduce the applied mineral nitrogen fertilizer rates and improve soil properties.

MATERIALS AND METHODS

A field experiments was carried out during two successive summer seasons of 2007 and 2008 at Sahl El-Hossinia village El-Rowad, El- Sharkia Governorate. The main target of this experiment is to evaluate the use of compost (residual straw of rice, corn and faba bean), compost tea and bio-fertilizer by soaking and /or foliar spraying (applied either each alone or in combination with different N- levels) on some chemical soil properties and growth, yield and yield components of rice cultivar Giza 187. Some chemical and physical analyses of the experimental soil are shown in Table (1). Statistically, the split plot design with three replications was used. The main plot was assigned to the fertilizer type and sub main plot was for the nitrogen levels (25, 50 and 100 kg N /fed).

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

Location	Course sand (%)	Fine sand (%)	Silt (%)	Clay (%)		Soil Texture	OM (%)		$CaCO_3$ (%)
El-Rowad village	3.46	50.37	10.95	35.22		Sandy clay	0.54		12
	pH (1:2.5)	EC* (dSm^{-1})	Cations (meq/l)				Anions (meq/l)		
			Ca^{++}	Mg^{++}	Na^+	K^+	HCO_3^-	Cl^-	SO_4^{--}
	8.33	17.59	9.70	15.38	150	0.83	9.27	122	44.64
	Available Macronutrients (mg/kg)			Available Micronutrients (mg/kg)					
	N	P	K	Fe	Mn	Zn	Cu		
	38	5.61	183	2.48	3.98	0.72	0.081		

*** EC. Estimated in soil paste**

The obtained data were statistically analyzed as described by Gomez and Gomez (1984). *Azospeirillum braselence* NO. 40 (salt tolerant PGPR strain) was provided by the biofertilizer unit, Soil Microbiology, Soils, Water and Environ. Res. Inst. Agric. Res. Center Giza, Egypt was applied as bio-fertilizer. Compost was plowed 25 days before rice trams planting at a rate of 10 ton fed^{-1}. The preparation of compost was done by using two ton of straw crop residuals (straw rice, maize stover and faba bean straw), air – dried made into 5 – 10 layers, each about 50cm thick. Farmyard manure at a rate of 300 kg/ pile was added to enhance microorganism activity, and it was then soaked with a sufficient quantity of water. Every 21 days, the heap of crop residuals was turned over until it became well decomposed. Chemical composition of the used compost is shown in Table (2). Composted tea was prepared by soaking one m^3 from the previous compost in 500 L water, for 48 hrs, then filtered and the leachate was then used as compost tea. The chemical analysis of compost tea is shown in Table (3). The compost and compost tea analyses were done according to the standard methods as described by Brunner and Wasmer (1978). Rice grains were coated with an inoculum of *Azopirillum* (bio-fertilizer) and then soaked in the solution of compost tea for 6 hrs before sowing. The obtained leachate (compost tea) was also used as a foliar spray for rice plants after 25, 50 and 75 days from rice sowing at the rate 100 L/ fed. The inoculated grain plots were also to supplied with a culture suspension of *Azopirillum* through drilling into soil near rice plants three times after 25, 50 and 75 days of sowing at the rate of 5L/100L/fed (Omar *et al.*., 2000). Urea (46 N %) was the source of mineral nitrogen fertilizer, which was applied at the rates of 25 – 50 and 100 kg N /fed alone or combined with compost, compost tea and bio-fertilizer. Calcium super-phosphate (15.5 % P_2O_5) was added at the rate of 30 kg P_2O_5 /fed during soil preparation, while potassium sulfate (48 % K_2O) at the rate of 100 kg K_2O/fed was added in two equal split doses before sowing and after 35 days from sowing.

Rice grains (Oryza Sativa) Giza (178) were obtained from the Field Crop, Res. Inst., ARC. The experiment started on the 5th of May 2007 for the first season in the 3rd of May 2008 for the second season.

Soil analysis: The soil surface (0- 30 cm) sample was collected, air – dried , passed through a 2 mm sieve and mixed thoroughly according to Piper (1950). Calcium carbonate was determined using a Calcimeter and calculated as $CaCO_3$ %. Organic matter was measured as described by Jackson (1976) .Total soluble salts were determined in the saturated soil paste according to Jackson (1976). The pH was measured using a pH meter in soil suspension (1: 2.5) soil water (Richards, 1954). Soluble cations and anions were determined in soil paste extract according to Black (1965). Available nitrogen was measured according to the modified Kjeldahal method by Black (1965). Available phosphorous was extracted by 0.5 N sodium bicarbonate and determined calorimetrically according to Olsen s' method (Jackson, 1976). The available K was determined using the flame photometer according to Soltanpour and Schwab (1977). Available micronutrients were extracted using ammonium bicarbonate (DTPA) and determined using Inductively Coupued Plasma (ICP) Spectrometry model 400, as described by Soltanpour and Schwab (1977).

Plant analysis:

Rice was harvested and grains were separated. Straw and grains were air dried and recorded as yield in ton /fed. Plant samples of ten a random plants were collected from each plot one day before harvesting , divided into grains and straw , air dried and then oven dried at 70 ^oC, weighted to obtain dry matter of grains and straw per plant. The plant part samples were ground, 0.5 g of each sample was digested using H_2SO_4 and $HClO_4$ mixture according to the methods described by Black (1965). The plant content of N, P, K, Fe, Mn, Zn, and Cu were determined in plant digestion using the methods described by Jackson (1976), Cottenie *et al..* (1982) and Page *et al..* (1982).

Table (2): Chemical analysis of the applied compost

Moisture content %	EC dSm^{-1}	pH	C	C/N	O.M	N	P	K	Fe	Mn	Zn	Cu
		(%)							($mgkg^{-1}$)			
22-27	3.35	7.4	27	9.1	33	2.87	0.83	1.37	225	97	130	44

Table (3): Chemical analysis of the applied compost tea

EC (dSm^{-1})	pH	C	O.M	N	P	K	Fe	Mn	Zn	Cu
		(%)					($mgkg^{-1}$)			
1.6	7.29	12	42	2.21	0.60	1.23	135	82	112	34

RESULTS AND DISCUSSION

Effect of bio- and organic fertilizers applied under different levels of nitrogen on yield and yield components:

Direct effect of bio-fertilizer, compost and compost tea applied under different nitrogen levels during both tested seasons on rice yield are shown in Table (4). Results showed that the values of dry matter yields in both seasons increased with increasing N mineral rate in combination with bio-fertilizer, compost and compost tea. These increases in both rice straw and grain yields are noticed in all the studied experimental plots. It was observed in Table (4) that the weight (ton /fed) of rice plant was significantly increased due to the use of the tested treatments in combination with different N-levels. In this regard, the response to compost was more pronounced as compared to other amendments when applied with chemical fertilizer. The yield of rice straw and grains tended to increase due to the use of different amendments, since it was 2.096 ton /fed for the mineral N- rates of 100kg N, 4.851 ton /fed for bio-fertilizer combined with 50 kg N /fed, 4.947 ton/fed for compost combined with 100kg N /fed and 4.685 ton/ fed for compost tea combined with 50 kg N/fed for straw. While, for grains, the corresponding increase was 1.973 for the mineral N- rates of 50kg N /fed; 4.026 for bio-fertilizer combined with 50 kg N/fed ; 4.366 ton/fed for compost combination with 100kg N /fed and 4.261 ton/fed for compost tea combined with 50 kg N/fed in the first season , while the highest values in the second season were 2.159, 4.851 4.998 and 4.752 Ton /fed for straw and 1.985, 4.149 , 4.372 and 4.266 ton/fed for grains due to 100kg N/fed , bio-fertilizer combined with 50 kg N /fed, Compost and compost tea both combined with 100 kg N/fed, respectively. Application of amendments combination with any level of mineral N – mineral fertilizer increased significantly grains/plant (g), 1000-grain (g) and grain yield index (%) in both seasons compared to the treatments received N- mineral fertilizer alone in both seasons. These findings are in harmony with those reported by Tiwari *et al.* (2001) and Shaban *et al.* (2008).

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It is worthy to mention that the superiority of crop yields under the studied treatments was in the following order: compost > Bio-Fertilizer > compost tea > N-mineral fertilizer and this was mainly due to the low EC_{iw}, which positively affected soil salinity and sodicity during the studied throughout crop cultivation.

N, P and K concentrations in rice (straw and grains):

Data of N, P and K concentrations in both straw and grains of rice as affected by the studied bio- and organic fertilizers are presented in Table (5) Results of N, P and K concentrations in straw and grain of rice showed pronounced decreases with increasing soil salinity. The sufficient concentrations of N, P and K ranged 2.07 - 2.45; 0.21–0.50 and 1.51 – 3.0 % for N, P and K, respectively as mentioned by Benton *et al..* (1992). Low values of N, P and K contents were observed at mineral –N < bio-fertilizer < compost > compost tea combined with 25 kg N /fed. While the highest contents of N were 2.36 % for straw and 1.82 % for grain, 2.41% for straw and 2.13% for grains and 2.37 % for straw and 2.09 % for grains for P contents ; 0.35 % for straw and 0.45 % for grains ; 0.38 for straw and 0.49 % for grain and 0.36 % for straw and 0.47 % for grain and for K contents 2.03 % for straw and 1.55% for grain ; 2.12 % for straw and 1.60 % for grain and 2.07 for straw and 1.59 % for grain of K for Bio-fertilizer combined with 50 kg N/fed; compost or compost tea combined with 100 kg N /fed respectively . These results are in agreement with those obtained by Hussein and Radwan (2001). Generally, the obtained increases in macronutrient concentration in straw and grains may be due to the decrease of soil pH, soil salinity, and the increased activity of microorganisms in soil. Foliar fertilization with compost tea allows nutrients to be absorbed by the plants directly through stomata on their leaf surfaces. Compost tea can also provide nutrients to the soil through soil drenches. These results agreed with those obtained by Lobna *et al..* (2006).

Data in Table (5) showed a significant increase effect on grain protein content due to the combination of N- fertilizer with bio- fertilizer, compost and compost tea. It was responded to increasing nitrogen levels up to 100 kg N/fed in both seasons, . This effect might be due to the increasing of available nitrogen for plant metabolism. Similar results were reported by Abou-Khalifa (1996), Badawi (2002) and Salem (2006). Finally, the use of bio-fertilizer combined with 50 kg N, and compost or compost tea in combination with 100 kg N recorded the highest N, P and K contents of both straw and grains in favor of compost treatment.

Micronutrients concentrations in rice straw and grains:

Effects of bio and organic fertilizer application under different mineral N- fertilizer levels on the concentration of some micronutrients (Fe, Mn, Zn and Cu), in both straw and grains of rice plants are presented in Tables (5). Data showed that applying the amendments caused markedly increases in the concentrations of Fe, Mn, Zn, and Cu in rice plants, with a more pronounced increase with increasing the level of N- mineral fertilizer.

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The highest contents of Fe, Mn, Zn, and Cu in rice straw were 98.06, 70.12, 46.58, and 6.29 mg/kg against 62.35, 27.66, 22.26, and 2.41 mg/kg for grains, respectively, for compost combined with 100kg N/fed compared with all other treatments .These results are in harmony with those obtained by Shaban and Helmy (2006) and Lobna *et al..* (2006). The relative increases of the studied micronutrients (Fe, Mn, Zn and Cu) in rice crop (straw and grains) are mainly depending on the used bio and organic fertilizers which, could be arranged as follows:

Compost > bio-fertilizer > compost tea > mineral N- fertilizer for Fe in straw and grins. Compost > compost Tea > Bio-fertilizer > mineral N –fertilizer for Mn, Zn and Cu in straw and grains, respectively. All this micronutrients concentration in straw and grains were in sufficient critical limit according to Benton *et al.* (1992).

Some chemical soil properties as affected by bio and organic fertilizers:

Soil reaction (pH):

Throughout this work, the chemical fertilizer and bio-fertilizer, compost and compost tea contributed to the decrease of soil pH.

Table (6) postulated that the use of different N- fertilizer levels, generally, exhibited the highest soil pH values. It was also found that soil pH tends to decrease slightly due to the application of compost, compost tea and bio-fertilizer. The soils of all experimental plot were characterized by slight to moderate alkaline conditions, where the pH value is always around 8.28 – 7.94. These findings are in agreement with those reported by Wahdan *et al..* (1999). . Data present in Table (6) showed also that soil pH tends to decrease slightly throughout the two seasons with increasing the N- mineral fertilizer level combined with bio-fertilizer, compost or compost tea; hence values of pH soil were ranged between 8.00 to 8.22 in the first season and 7.94 to 8.15 in second seasons. The lowest value of pH 7.94 was obtained in the soil treated with compost combined with 100 kg N/fed. These findings are in agreement with those reported by Rebeka (2006). The application of compost, compost tea and bio-fertilizer in general reduced the soil pH. The pH of saline sodic soil was reduced from (8.28 - 8.00) to (8.15 - 7.94) due to the application of bio and organic fertilizers treatments after rice harvesting in both seasons.

Soil salinity (EC) as affected by different fertilizer sources:

Soil salinity after rice harvest as affected by different fertilizer sources is given in Tables (6). Results showed that the studied soils are generally characterized, by a saline nature the characters that prevailed in the semi-arid regions. These characters include the accumulation of salts in surface zone of the soil, mainly due to high evaporation process under the dry and hot climate. Data in Table (6) revealed that the values of soil salinity ECe (dS/m) decreased significantly by increasing mineral nitrogen fertilizer levels combined with bio-fertilizer or compost and compost tea. Concerning the effect of mineral nitrogen fertilizer levels or bio-fertilization on soil salinity and salt distribution, the degrees of soil salinity were slightly affected. These results are in agreement with those obtained by Burr *et al..* (1978). Application of bio and organic fertilizer combined with different nitrogen levels led to a decrease in soil salinity because bio- fertilizer or compost and/or compost tea could improve the soil physical properties (increasing soil porosity).

Table (6): Soil reaction (pH), electric conductivity (EC) and N, P and K contents in soil after rice harvesting as affected by bio, organic and nitrogen fertilizers during 2007 and 2008 seasons

Treatments	N rate kgfed^{-1}	pH (1:2.5)	EC (dSm^{-1})	Available macronutrients (mgkg^{-1})		
				N	P	K
Season 2007						
N- Mineral	25	8.28	13.69	46	5.86	197
	50	8.21	12.96	64	5.90	214
	100	8.18	12.73	69	6.03	221
Mean			13.12	59	5.93	211
Bacteria (NO40)	25	8.20	12.66	60	5.94	208
	50	8.12	11.28	77	6.12	217
	100	8.01	10.82	82	6.54	234
Mean			11.59	73	6.20	219
Compost	25	8.22	12.84	58	5.98	210
	50	8.14	11.75	73	6.24	219
	100	8.07	10.99	79	6.88	238
Mean			11.86	70	6.37	222
Compost (tea)	25	8.18	12.14	68	6.02	211
	50	8.06	11.05	83	6.34	221
	100	8.00	10.33	86	6.81	240
Mean			11.17	79	6.39	224
Season 2008						
N- Mineral	25	8.15	10.22	56	6.13	208
	50	8.13	10.46	78	6.38	221
	100	8.10	10.29	82	6.57	229
Mean			10.32	72	6.36	219
Bacteria (NO40)	25	8.08	10.19	62	6.23	215
	50	8.07	9.96	85	6.58	224
	100	7.97	9.91	92	6.69	238
Mean			10.02	80	6.50	225
Compost	25	8.04	10.05	64	6.49	220
	50	8.01	9.81	93	6.88	230
	100	7.94	9.74	96	6.94	244
Mean			9.87	84	6.77	231
Compost (tea)	25	8.06	10.04	65	6.45	218
	50	8.00	9.59	90	6.87	227
	100	7.98	9.76	94	6.91	243
Mean			9.79	83	6.74	229
LSD %5 fertilizer		1.07	0.087	3.12	0.36	7.01
LSD % N Rate		ns	0.068	3.24	0.35	6.82
LSD % 5 season		ns	0.173	0.21	0.20	10.04

These findings are in agreement with those reported by Tandon (2000) who found that physical properties (hydraulic conductivity, bulk density and total porosity) of salt affected soil greatly improved when compost is applied. The decomposition of compost and compost tea and bio-fertilizer releases acids forming compounds and active microorganisms, which react with the soluble salts already present in soil either to convert them into soluble salts or at least increase their solubility .

Available macronutrient contents in the soil:

Nitrogen, Phosphorus and Potassium are the major elements for plant growth. Data in Table (6) showed the amounts of some available macronutrients, N, P and K (mg/kg soil) in the studied soil as affected by bio, organic and N fertilizers during both seasons. In fact the compost and compost tea combined with high rate of nitrogen fertilizer are rich in organic materials as well as N, P and K. Results also, indicated that available N, P and K ranged from 46 to 86 mg/kg soil in first season and from 56 to 96 mg/kg soil in second season for N**,** from 5.86 to 6.88 mg/kg in first season and from 6.13 to 6.94 mg/kg in second season for P and from 197 to 240 mg/kg in the first season and from 208 to 244 mg /kg in the second season for K. The highest values of 96, 6.94 and 244 mg/kg soil for N, P and K, respectively, were obtained in soil treated with compost combined with high level of mineral N- fertilizer compared to other treatments. Values of available N, P and K increased significantly with addition of compost and compost tea combined with high level of N-mineral fertilizer but the N, P and K increased with bio-fertilizer combined and with 50 % N mineral fertilizer. The decomposition of applied compost, compost tea and bio-fertilizer resulted in reduction of soil pH as various acids (amino acids, such as glycine and cystein as well as humic acid) or acid forming compounds and active microorganisms were released from the addition of organic materials and bio-fertilizer. These findings are in agreement with those reported by (Brady and Weil, 2005). This reduction in soil pH increased the availability of nutrients in alkaline soil that become available to the plants.

Micronutrients content in soil as affected by bio, organic and mineral nitrogen fertilizers:

Data in Table (7) bio-organic and mineral nitrogen that pronounced increases in soil available microelement contents (Fe, Mn, Zn and Cu) were achieved as a result of the application of compost or compost tea and bio-fertilizer combined with N- mineral fertilizer levels during both seasons under rice cropping. This is more related to the residual of organic compounds that are directly decomposed after different biochemical and chemical changes, which led to the release of more available microelements. These findings are in agreement with those obtained by Shaban and Helmy (2006). The highest values were 2.93 and 3.36 mg/kg for Fe; 5.28 and 5.37 mg/kg for Mn, 1.09 and 1.26 mg/kg for Zn and 0.19 and 0.25 mg /kg for Cu soil during the first season and second season, respectively .It is worthy to mention that the contents of all the studied available microelements, in general, lay within the sufficient limits of Fe and Mn or in the critical limits identical division for the others (FAO, 1992).

Table (7): Available micronutrient contents in the soil after rice harvesting as affected by bio, organic and nitrogen fertilizers during 2007 and 2008 seasons

Treatments	N / unit	Macronutrients			(mgkg^{-1})
		Fe	**Mn**	**Zn**	**Cu**
Season 2007					
N- Mineral	25	2.53	4.04	0.85	0.10
	50	2.79	4.15	0.88	0.14
	100	2.81	4.32	0.93	0.16
Mean		2.71	4.17	0.89	0.13
Bacteria (NO40)	25	2.60	4.13	0.89	0.12
	50	2.88	4.59	1.02	0.15
	100	2.90	4.78	1.06	0.18
Mean		2.79	4.50	0.99	0.15
Compost	25	2.64	5.02	1.01	0.14
	50	2.89	5.21	1.06	0.19
	100	2.93	5.28	1.09	0.18
Mean		2.82	5.17	1.05	0.17
Compost tea	25	2.62	4.87	0.99	0.13
	50	2.85	4.96	1.05	0.15
	100	2.88	4.99	1.07	0.17
Mean		2.78	4.94	1.03	0.15
Season 2008					
N- Mineral	25	2.69	4.35	1.02	0.12
	50	2.80	4.39	1.09	0.16
	100	2.84	4.42	1.13	0.18
Mean		2.77	4.38	1.08	0.15
Bacteria (NO40)	25	2.63	4.44	1.11	0.14
	50	2.94	4.63	1.18	0.20
	100	2.91	4.80	1.22	0.22
Mean		2.82	4.62	1.17	0.18
Compost	25	3.17	5.25	1.15	0.16
	50	3.33	5.32	1.19	0.23
	100	3.36	5.37	1.26	0.25
Mean		3.29	5.31	1.20	0.21
Compost (tea)	25	3.15	5.10	1.06	0.17
	50	3.30	5.16	1.13	0.19
	100	3.32	5.23	1.18	0.21
Mean		3.26	5.16	1.12	0.19
LSD %5 fertilizer		1.12	0.079	0.14	0.0023
LSD % N Rate		ns	0.078	0.44	0.0027
LSD % 5 season		2.42	0.120	0.94	0.0144

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تأثير الكمبوست ومستخلص الكمبوست والتسميد الحيوي على بعض صفات التربة وإنتاجية محصول الأرز تحت ظروف التربة الملحية

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أجريت تجربتين حقليتين لموسمين صيف ٢٠٠٧ و٢٠٠٨ في مزرعة خاصة بقرية الرواد بمنطقة سهل الحسينية – محافظة الشرقية – مصر. لدراسة تأثير استخدام التسميد الحيوي (بكتريا ازوسبيريللم المقاومة للملوحة NO. 40) والكمبوست ومستخلص الكمبوست مع مستويات مختلفة من التسميد النتروجينى المعدني (٢٥ – ٥٠ – ١٠٠ كجم نيتروجين لكل فدان) في صورة سماد يوريا ٤٦ % نيتروجين (والكمبوست عبارة عن مخلفات نباتية من قش محصول القمح والذرة والفول البلدي مع السماد البلدي اما مستخلص الكمبوست عبارة عن منقوع الكمبوست السابق) على إنتاجية محصول الأرز صنف جيزة ١٧٨ وبعض الصفات الكيميائية للتربة تحت ظروف الملوحة .

ويمكن تلخيص النتائج المتحصل عليها فيما يلى :

- وجد أن إضافة التسميد الحيوي والكمبوست ومستخلص الكمبوست مع المعدلات العالية من التسميد النتروجينى يؤدى إلى زيادة إنتاجية الفدان من محصول القش والحبوب وكذالك زيادة القش والحبوب للنبات الواحد ووزن ألف حبة وكذلك الدليل المحصولي .
- أدى استخدام الأسمدة العضوية والحيوية إلى زيادة تركيز العناصر الكبرى في القش والحبوب نظرا لتأثر تلك العناصر بتلك الأسمدة المضافة مما خفض رقم الحموضة pH مما سهل تيسر العناصر وامتصاص النبات لها . كذلك زادت نسبة العناصر الصغرى تحت الدراسة وهى الحديد والمنجنيز والزنك والنحاس زيادة معنوية مع التسميد العضوي والحيوي تحت مستويات التسميد المعدني المختلفة وكانت هذه الزيادة في الحدود الكافية للنبات (القش والحبوب).
- كما تأثرت درجة إل pH بإضافة الأسمدة فتراوحت قيمها من ٨,٢٨ إلى ٨,٠٠ في الموسم الأول وانخفض هذا المدى إلى من ٨,١٥ إلى ٧,٩٤ في الموسم الثاني .
- انخفضت قيم ملوحة التربةEC بإضافة الأسمدة الحيوية والعضوية من ١٣,٦٩ إلى ١٠,٣٣ ديسسيميز/سم في الموسم الأول ومن ١٠,٢٢ إلى ٩,٧٤ ديسسيميز/سم.
- زادت قيم العناصر نتروجين - فوسفور- بوتاسيوم الميسرة في التربة بإضافة الكمبوست ومستخلص الكمبوست والسماد الحيوي مع المعدلات المختلفة من التسميد النتروجينى المعدني.
- أدى إضافة الكمبوست والسماد الحيوي ومستخلص الكمبوست إلى زيادة العناصر حديد- منجنيز زنك – نحاس الميسرة في التربة .

Table (4): Rice yield and its components as affected by bio-and organic fertilizer under mineral N fertilization during 2007 and 2008 seasons

Treatment	N / unit	Weight of plant (g)				Weight of yield (ton fed^{-1})				Weight (1000)grains (g)		Yield index (%)	
		Straw		Grains		Straw		Grains					
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
Mineral	25	2.52	2.66	1.25	1.29	0.124	0.139	0.059	0.064	20.58	19.96	32	31
	50	2.84	2.88	1.28	1.32	2.096	2.159	1.973	1.985	24.63	24.66	48	48
	100	2.93	2.95	1.35	1.36	3.178	3.457	2.998	3.156	26.39	26.45	48	47
Mean		2.76	2.83	1.41	1.32	1.800	1.918	1.676	1.735	23.87	23.69	43	42
Bacteria (NO40)	25	2.62	2.66	1.33	1.36	0.356	0.361	0.089	0.096	22.46	22.50	25	21
	50	2.98	3.02	2.54	2.56	4.769	4.851	4.026	4.149	28.66	28.69	45	46
	100	2.88	2.93	2.44	2.47	2.953	2.971	2.327	2.339	27.82	27.88	49	44
Mean		3.83	2.87	2.10	2.13	2.693	2.728	2.147	2.195	26.31	26.36	40	37
Compost	25	2.64	2.67	1.36	1.38	0.359	0.366	0.102	0.109	22.48	22.50	22	23
	50	3.01	3.05	2.59	2.63	4.896	4.925	4.347	4.352	29.16	29.24	47	47
	100	3.06	3.09	2.61	2.66	4.947	4.998	4.366	4.372	29.23	29.26	46	46
Mean		2.90	2.94	2.19	2.22	3.400	3.430	2.938	2.944	26.96	27.00	38	39
Compost tea	25	2.60	2.63	1.35	1.37	0.298	0.296	0.123	0.128	22.36	22.40	29	30
	50	2.99	3.03	2.61	2.64	4.685	4.752	4.258	4.261	28.63	28.65	47	47
	100	3.02	3.05	2.63	2.65	4.648	4.667	4.261	4.266	28.69	28.72	48	47
Mean		2.87	2.90	2.20	2.22	3.210	3.240	3.045	2.885	26.56	26.59	41	41
LSD %5 fertilizer		0.76		0.081		0.34		0.37		ns		1.44	
LSD %5 Rate		0.58		0.084		0.26		0.11		6.35		2.45	
LSD % 5 Seasons		0.47		0.109		0.09		0.113		ns		3.73	

Table (5) Macro and micronutrient concentrations in rice straw and grain as affected by bio-and organic fertilizer under mineral N fertilization

Treatment	N / unit	N (%)		P (%)		K (%)		Fe (mgkg^{-1})		Mn (mgkg^{-1})		Zn (mgkg^{-1})		Cu (mgkg^{-1})		Protein (%)
		Straw	grain	Straw	Grain	Straw	grain	Straw	Grain	Straw	grain	Straw	Grain	Straw	Grain	
Mineral	25	2.19	1.26	0.23	0.35	1.88	1.24	89.63	61.10	58.12	25.48	35.94	19.17	4.69	2.19	7.24
	50	2.25	1.72	0.29	0.38	1.96	1.35	91.72	61.15	64.16	27.43	39.25	21.38	4.73	2.25	9.89
	100	2.34	1.79	0.31	0.40	2.01	1.38	96.21	61.19	66.24	27.48	40.20	21.44	4.88	2.28	10.29
Mean		2.26	1.59	0.27	0.37	1.95	1.32	92.52	61.14	62.84	26.79	38.46	20.66	4.77	2.24	9.14
Bacteria (NO40)	25	2.24	1.59	0.25	0.37	1.93	1.48	91.18	62.24	63.14	25.75	38.66	21.24	5.26	2.26	9.14
	50	2.36	1.82	0.32	0.42	1.99	1.52	93.34	62.28	66.47	27.55	41.21	22.10	5.33	2.29	10.46
	100	2.29	1.86	0.35	0.45	2.03	1.55	97.38	62.30	67.19	27.61	42.16	22.18	5.42	2.31	10.69
Mean		2.29	1.76	0.31	0.41	1.98	1.51	93.97	62.27	65.60	26.97	40.68	21.84	5.34	2.29	10.10
Compost	25	2.28	1.92	0.28	0.39	2.01	1.51	93.10	62.28	64.29	26.14	40.00	21.89	6.14	2.35	11.04
	50	2.34	2.09	0.34	0.45	2.08	1.58	95.20	62.33	68.09	27.62	44.10	22.17	6.21	2.38	12.02
	100	2.41	2.13	0.38	0.49	2.12	1.60	98.06	62.35	70.12	27.66	46.58	22.26	6.29	2.41	12.25
Mean		2.34	2.05	0.33	0.58	2.07	1.56	95.45	62.32	67.50	27.14	43.56	22.11	6.21	2.38	11.77
Compost tea	25	2.24	1.88	0.26	0.35	1.98	1.50	92.97	62.32	63.86	26.13	39.58	21.81	6.12	2.33	10.81
	50	2.29	2.07	0.33	0.44	2.05	1.54	94.88	62.25	67.84	27.60	42.56	22.15	6.17	2.34	11.90
	100	2.37	2.09	0.36	0.47	2.07	1.59	96.79	62.29	68.91	27.63	44.29	22.23	6.19	2.39	12.02
Mean		2.30	2.01	0.31	0.42	2.03	1.54	94.88	62.29	66.87	27.12	42.14	22.06	6.16	2.35	11.57
LSD%5 fertilizer		0.51	0.24	0.0067	6.96	0.40	3.43	2.89	ns	1.48	0.57	0.028	ns	ns	0.57	1.35
LSD%5 N Rate		0.57	0.49	0.0065	ns	0.98	ns	5.72	3.06	1.70	0.64	0.032	ns	5.40	0.64	ns