SOIL CHEMICAL PROPERTIES AND WHEAT PRODUCTIVITY AS AFFECTED BY ORGANIC, BIO-FERTILIZATION AND CULTIVATION METHODS IN SALINE SOIL

Enshrah I. M . El-Maaz, Hoda M. R. M. Ahmed and Kh.A. Shaban
Soils, Water and Environ. Res. Inst., Agric. Res. Center, Giza, Egypt

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ABSTRACT: *A field experiment was conducted in saline loamy sand soil located in Sahl El-Tina (a private farm) at North Sinai Governorate, during the two successive winter seasons of 2011/2012 and 2012/2013. The current study aimed to evaluate the effect of cultivation methods (row, raised bed and flat), using organic fertilizer (compost) and bio- fertilizer on some soil chemical properties, availability of some macro and micro nutrients in the soil and wheat grains (masr, 2) and wheat productivity under newly soil conditions. The obtained results indicated a noticeable reduction in soil pH and salinity after wheat harvest as a result of treating the soil with bio fertilizer or compost especially sowing on raised bed. However, the OM content and cation exchange capacity of the soil after wheat harvest were increased by the studied treatments. The high increase was attained by using compost or bio fertilizer with raised bed.*

Results also showed that, the wheat plant grown under all the studied treatments gave higher yield than the control under saline soil conditions and the highest values of straw and grain yields were recorded by using bio fertilizer or compost fertilization when grains were sown on row.

The treatments with bio and organic fertilizers resulted in an increase in the soil content of available N, P, K and Fe, Mn and Zn after harvest. Also, there was a significant increase in N, P and K contents of wheat grains with bio-fertilizer or compost treatments compared with control. The same treatments caused an increase in the concentrations of Fe, Mn and Zn in grains.

Key words: *Chemical properties- Compost - Bio-fertilizer- Wheat productivity–Saline soil.*

INTRODUCTION

Egypt vitally needs sustained agricultural development to cope with the social and economic obligations that are the normal consequences of the continued high rates of population growth. This urgent need requires continuous scientifically based implementation of effective agricultural practices. Wheat (Triticum aestivum L.) is the most important cereal crop in Egypt. Increasing wheat production is an essential national target to fill the gap between production and consumption. (Zaki *et al.,* (2004) and (Zeidan *et al.,* 2009). Increasing cultivation in new reclaimed desert lands became a vital subject, these soils characterized with poor fertility, low water holding capacity, high leaching and alkaline pH. The use of organic fertilizer in such soil showed a good means in that concern. Numerous studies have shown a substantial increase in growth and yield of wheat plant in reclaimed desert lands (Shoman *et al.,* 2006; Badr *et al.,* 2009; Sary *et al.,* 2009 and Wali Asal, 2010).

Unfortunately, many factors are contributing to reduce crop yield. One of these factors is the salinity soil which is a biotic stress factors. Egypt has an area of about one million square kilometers or 238 million feddans (one feddan = 0.42 ha). The total agricultural land in Egypt amounts to nearly 8.4 million feddans (3.5 million ha) and accounts for around 3.5 percent of the total area. One million ha in the irrigated areas suffer from salinization problems, water logging and sodicity (FAO, 2005). The majority of salt-affected soils in Egypt are located in the Northern central part of the Nile Delta and on its Eastern and Western sides. About 900 000 ha suffer from salinization problems in cultivated irrigated areas, 6 % of Northern Delta region are salt-affected, 20 % of the Southern Delta and Middle Egyptian region and 25 % of the Upper Egypt region (FAO, 2003). Million hectares of arable land too saline for agriculture and hundreds of thousands hectares of agriculture productive land are lost annually for food production due to salinization (FAO, 2008).

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, 1993). The combined application of both organic and inorganic fertilizers improved chemical properties of soil and enriched the fertility status of soil (Sarwar *et al.,* 2008). The role of compost in salt-affected soils is very vital because the organic source is ultimate opportunity to improve the physical properties of such soils which have been deteriorated to the extent that water and air passage become extremely difficult in such soils. Resultantly, the water stands on the surface of these soils for weeks long. The plants when grown under these conditions often die due to deficiency of root respiration. The compost can be a very good organic amendment in saline agriculture as well as for reclamation of salt-affected soils (Zaka *et al.,* 2003). Soil organic matter encourages granulation, increases cation exchange capacity (CEC) and is responsible for up to 90 % adsorbing power of the soils. Cations such as Ca^{2+}, Mg^{2+} and K^{+} are produced during decomposition (Brady and Weil, 2005). Soliman and Hassan (2004) showed that the application of organic materials either alone or in combination with mineral fertilizers caused a substantial increase in soil available N, P and K.

Use of soil microorganisms which can either fix atmospheric nitrogen, solubilize phosphate, synthesis of growth promoting substances or by enhancing the decomposition of plant residues to release vital nutrients and increase humic content of soils, will be environmentally begin approach for nutrient management and ecosystem function (Wu *et al.,* 2005). Application of biofertilizer is considered today to limit the use of mineral fertilizers and supports an effective tool for desert development under less polluted environments, decreasing agricultural costs, maximizing crop yield due to providing them with an available nutritive elements and growth promoting substances (Metin *et al.,* 2010).

Bio-fertilizers are being essential component of organic farming are the preparations containing live or latent cells of efficient strains of nitrogen fixing, phosphate solubilizing or cellulolytic micro-organisms used for application to seed, soil or composting areas with the objective of increasing number of such micro-organisms and accelerate those microbial processes which augment the availability of nutrients that can be easily assimilated by plants. Biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilize insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization (Venkatashwarlu, 2008).

This work aims assessing the effects of cultivation methods (row, raised bed and flat), organic fertilizer (compost) and bio-fertilizer on some soil chemical properties, availability of some macro and micro nutrients in the soil and wheat productivity and its quality under newly reclaimed saline soil conditions.

MATERIALS AND METHODS

A field Experiment was conducted in Gelbana village at North Sinai Governorate during the two winter growing seasons 2011/2012 and 2012/2013 , to study the evaluation of different cultivation methods (raised bed , flat and row) and different nitrogen fertilizer sources (mineral N ; bio-fertilizer and compost) on some soil chemical and wheat productivity in saline soil. The experiment was conducted in as split plot design with three replicated. The cultivation methods system (raised bed 2 m long , 1.0 m wide and 15 cm high) , (row 2 m long , 50 cm wide and 15 cm high) and (flat 2 m long , 1.0 m wide and 0.0 cm high) respectively the min plot. The mineral N (100 kg N /fed) (control), Bio-fertilizer + 75 kg N /fed and compost + 75 kg N /fed were sub plots. This location of study was irrigated from El-Salam Canal (Nile water mixed with agriculture drainage water 1:1). The mean values of irrigation water properties are shown in Table (1).

To control soil salinity, water was applied immediately after sowing for 4 hours and then the excess water was surface drained in same day of sowing. The same process was repeated in the second day. After that, irrigation water was added every 10 days until the end of the growing seasons.

The main values of physical and chemical properties of the cultivated soil and also their content of some macro-micronutrients were determined before sowing according to the methods described by Jackson (1973), Cottenie *et al.,* (1982) and Page *et al.,* (1982). The data was recorded in Table (2).

The area of each experimental unit (plot) was one faddan (4200 m^2) which divided into three divisions (raised bed; row and flat) and divided into three plot units with mineral N, compost and bio-fertilization were distributed randomly. Wheat grains (Masr 2) were sown on the 25 of November 2011 and 2012 respectively. The grains of wheat masr 2 were obtained from Crop Institute Agriculture Research Center, Giza Egypt. Grains were inoculated with *Rhiobium radiobacter*sp strain (salt tolerant PGPR) biofertilizer isolated from the rhizosphere soil of saline soil at sahl El-Tina and deposited in the Gen bank under number of HQ395610 Egypt by Bio-fertilizer Production Unit, Department of Microbiology, Soils, Water and Environment Research Institute, Agricultural Research Center, Giza, Egypt. The bio-fertilizer was applied at a rate of 700 g for 60 kg grains wetted with 300 ml of adhesive liquid (Arabic gum). More bio-fertilization was added 3 times at 21, 45 and 65 days after wheat planting through liquid sprays on soil at a rate of 200 L /fed. Compost applied was mixed with the soil 25 days before planting at the rate of 10 ton fed^{-1} .Chemical composition of the compost used is shown in Table (3).

Mineral fertilizer used as urea (46 % N) at application rate of 100 kg N/fed where it's applied in 3 equal doses after 21, 45 and 60 days from planting. Calcium super phosphate (15.5 % P_2O_5) was added at 200 kg calcium super phosphate /fed during soil preparation. Potassium sulphate (48 % K_2O) at 70 kg/fed was added on two equal doses after 21 and 45 days from planting. Wheat crop was harvested on 15 may 2012 and 20 may 2013.

Table (1): Chemical analysis of irrigation water

pH	EC (dsm^{-1})	Cations (mg L^{-1})				Anions (mg L^{-1})				SAR
		Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	CO_3^{2-}	HCO_3^-	SO_4^{2-}	
8.02	1.66	3.43	4.29	8.16	0.72	5.74	nil	3.83	7.03	2.95

Table (2). Physical and chemical properties of the studied soil before planting.

Crosse sand (%)	Fin sand (%)	Silt (%)	Clay (%)	Texture	O.M (%)	$CaCO_3$ (%)	CEC c mol/kg
5.29	74.56	7.52	12.63	Sandy Loam	0.56	7.63	24.45

pH (1:2.5)	EC (dS/m)	Available macronutrients (mg/kg)			Available micronutrients (mg/kg)			
		N	P	K	Fe	Mn	Zn	Cu
8.08	12.82	37.53	4.76	199	2.83	1.71	0.73	0.052

Table (3): Chemical composition of the compost used in the experiment .

EC(dS/m) (1:5) (Manure: water extr.)	pH (1:2.5) ((Manure: water sus.)	Bulk density (g/cm^3)	Water holding capacity (%)	O.M (%)	Total macronutrients (%)			C/N ratio
					N	P	K	
3.76	7.25	0.35	160	37.69	1.83	0.88	2.23	17.80

The Experiment treatments were as follow:

A- Raised bed:

1- Mineral nitrogen form Urea (46 % N) at rate 100kg N /fed, (control).
2- Compost + 75 kg N /fed
3- Bio-fertilizer + 75 kg N / fed.

B- Row:

4- Mineral nitrogen form Urea (46 % N) at rate 100kg N /fed, (control)..
5- Compost + 75 kg N /fed
6- Bio-fertilizer + 75 kg N / fed.

C – Flat:

7- Mineral nitrogen form Urea (46 % N) at rate 100kg N /fed (control).
8- Compost + 75 kg N /fed
9- Bio-fertilizer + 75 kg N / fed.

Soil sample:

Disturbed soil samples were also collected from 0- 30 cm soil depth, from each experimental plot after harvest in the two growth seasons. The soil samples were air - dried and analyzed for some chemical characteristics, i.e., soil pH, organic matter and cation exchange capacity according to the methods described by Page *et al.*, (1982). The total soluble salts expressed as EC (dS/m) were determined by using electrical conductivity meter at 25^{oC} in soil paste as dSm^{-1} (Jackson, 1973). Particle size distribution was carried out by the pipette method described by Gee and Bauder (1986) using sodium hexameta-phosphate as a dispersing agent. The content of available macronutrient (N, P and K) and micronutrients (Fe, Mn and Zn) in soil was determined according to the methods described by Cottenie *et al.,* (1982).

Plant analysis:

The plant part samples were ground, 0.5 g of each sample was digested using H_2SO_4, $HClO_4$ mixture according to the methods described by Chapman and Pratt (1961). The plant content of N, P, K, Fe, Mn and Zn were determined in plant digestion using the methods described by Cottenie *et al.,* (1982).

Statistical analysis:-

All data obtained from this study combined two seasons were statistically analyzed for analysis of variance (ANOVA) and least significant difference (LSD) at 0.05 probability level was applied to make comparisons among treatment means according to Gomez and Gomez (1984).

RESULTS AND DISCUTION

Soil chemical properties as affected by different treatments.

Soil pH:

Data presented in Table (4) show that soil pH values were decreased in all soil treated with compost or biofertilizer. Such decrease in pH values could be attributed to the production of CO_2 and organic acids by soil microorganisms acting and other chemical transformation on the added organic matter.

Soil pH decrease was moaned by using bio fertilizer or compost with raised bed cultivation method compared to control under all cultivation methods (row, raised bed and flat).Data in Table (4) showed an insignificant effect on soil pH by all soil treatments with different treatments. Hence, a decrease in soil pH due to any soil management strategy is always appreciable and results in ultimate conversion of soil medium towards favorable one and net translation into increased yields. Numerical values were a bit lower after wheat harvest in the same treatments indicating consistent positive impact of compost on this soil parameter. Smiciklas *et al.,* (2002), Pattanayak *et al.,* (2001) and Yaduvanshi (2001) also observed a decrease in soil pH after the use of organic materials. The production of organic acids (amino acid, glycine, cystein and humic acid) during mineralization (ammonization and ammonification) of organic materials by heterotrophs and nitrification by autotrophs would have caused this decrease in soil pH.

On the other hand, the increasing mineral nitrogen levels of application combined with bio-fertilizer led to decrease soil pH but less than the significant limit. This finding is expected to be due to the active microorganism, biological activity in particular and organic acid produced. Shaban and Omar (2006) indicated that the effect of different mineral nitrogen fertilizer with bio-fertilizer on Dehydrogenas activity and production of μ moles of H_2 in the rhizosphere of maize root media had a positive effect on increasing the hydrogen moles which react in root zone to form hydrocarbon acid led to decrease soil pH .

Soil EC:

Data in Table (4) show that the soil EC (dSm^{-1}) values decreased as a result of the different fertilizer sources. These results are in agreement with those of Ashmaye *et al.,* (2008), Poraas *et al.,* (2009) and Darwich *et al.,* (2012) who showed a decrease in EC value as a result of using bio fertilizer or compost in saline soil. The decrease was attained by using bio fertilizer or compost with raised bed sowing method compared by control with all cultivation methods (row, raised bed and flat) .Also, data showed a highly significant with methods and different sources fertilization, while non significantly with interaction between fertilizer sources and cultivation methods of soil electrical conductivity .The relative decrease of mean values EC (dSm^{-1}) were 17.35% for raised bed method and 11.31 % for row method respectively compared with cultivation method of flat. As well as , the relative decrease of mean values of soil EC as affected by compost and bio-fertilizer were 14.08 % for soil treated with compost and 11.71 % for soil treated with bio-fertilizer, compared with control , respectively. From the results it could be concluded that the raised bed method and compost application led to decrease of EC soil than other treatments. These results are in agreement with Ashour (2014) who revealed that the application of vermin compost led to decrease of soil EC.

Table (4): Chemical properties of the studied soil after wheat harvest (Average of two seasons).

Method of sowing	Treatments of fertilization	pH (1:2:5)	EC (dS/m)	O.M %	CEC c mol/kg
Flat	Control (100kg N fed^{-1})	8.04	9.41	0.59	27.00
	Compost + 75 kg N fed^{-1}	8.02	8.42	0.66	27.34
	Biofertilizer+75 kg N fed^{-1}	8.00	8.70	0.62	27.81
Mean		----	8.84	0.62	27.38
Raised bed	Control (100kg N fed^{-1})	8.02	7.00	0.60	31.99
	Compost + 75 kg N fed^{-1}	7.97	6.12	0.72	32.91
	Biofertilizer+75 kg N fed^{-1}	7.99	6.32	0.65	33.20
Mean		-----	6.48	0.66	32.70
Row	Control (100kg N fed^{-1})	8.03	8.93	0.60	30.00
	Compost + 75 kg N fed^{-1}	7.98	7.23	0.67	32.11
	Biofertilizer+75 kg N fed^{-1}	8.00	7.35	0.63	33.00
Mean		-----	7.84	0.63	31.70
Mean control		---	8.45	0.60	29.66
Mean compost		--	7.26	0.68	30.79
Mean biofertilizer		-----	7.46	0.63	33.00
LSD 5% fertilizer		ns	0.54	0.046	0.68
LSD 5% methods		ns	0.81	ns	1.15
Fert X Meth		ns	ns	ns	ns

Soil organic matter and cation exchange capacity:

Organic matter is regarded as the ultimate source of nutrients and microbial activity in the soil. It is the deciding factor in soil structure, water holding capacity, infiltration rate, aeration and porosity of the soil. Data presented in Table (4) showed that, the content (%) of O.M was increased by soil treated with compost and bio-fertilizer compared with control. The high increase was attained from compost especially raised bed cultivation method. The status of organic matter in the soil had a relationship with the quantity applied. The relative increases of mean values O.M. (%) content in soil were 6.45 % for raised bed cultivation method and 1.61 % for row cultivation method compared with flat cultivation method, respectively. On the other hand, the relative increases of mean values O.M (%) content in soil were 13.33 % for soil treated with compost and 5 .00 % for soil treated with bio-fertilizer compared with control, respectively. Generally the results obtained showed that the application of compost and used raised bed cultivation method led to increase of mean values of O.M. (%) compared with other treatments. These results are in agreement with those of Sarwar *et al.,* (2008); Agbede *et al.,* (2008) and Muhammad and Khattak, (2009) who found that the application of compost resulted in overall increase of the soil organic matter level.

The cation exchange capacity of the soil under different treatments took the same trend of organic matter and this may be attributed to that soil organic matter encourages granulation, increases cation exchange capacity (CEC) and is responsible for up to 90 % adsorbing power of the soils,(Brady and Weil, 2005).Data in Table (4) show that the CEC (cmol/kg)was significant as affected by different fertilizer sources, while the cultivation methods and interaction between fertilizers source and cultivation of methods were no significantly. The high mean value of CEC was 32.70 cmol/kg for raised bed cultivation method compared with other methods. The relative increases of mean values CEC content in soil were 19.43% for raised bed cultivation method and 15.77 % for row cultivation method, respectively compared with flat cultivation method. Also, the relative increases of mean values CEC content in soil were 3.81 % for soil treated with compost and 11.26 % for soil treated with bio-fertilizer compared with control respectively. Cations such as Ca^{2+}, Mg^{2+} and K^{+} are produced during decomposition (Brady and Weil, 2005). Walker and Bernal (2008) reported that the enrichment of the exchange complex in Ca^{2+} and Mg^{2+} can be particularly relevant in the reclamation of saline–sodic soils, since it could decrease the proportion of Na^{+} in the exchange complex, improving soil physical properties.

Macronutrient contents in the studied soil.

Data presented in Table (5) show the soil content (mg kg^{-1}) of available N, P and K as affected by the used fertilizers and cultivation methods. Data revealed that available N ranged from 60 to 74; P from 5.23 to 7.33 and for K from 265 to 295 mg/kg soil. The effect of bio-fertilizer and compost on N, P and K content in soil were significant increase, while the N and K content in soil were no significant as affected by different cultivation methods system. Phosphorus status of soil was improved significantly when using different cultivation methods after wheat crop. The interaction between different fertilizers and cultivation methods utilization were no significantly affect on N, P and K content in soil. The relative increase of mean values N, P and K as affected by different cultivation methods were 4.74 % and 2.75 % for N; 16.29 % and 11.96 % for P and 1.91 % and 0.48 % for K content in soil as affected by raised bed and row cultivation methods compared with flat method. On the other hand the relative increase of mean values N, P and K content in soil as affected by different fertilizers were 14.37 % and 10.60 % for N ; 14.72 % and 21.10% for P and 4.90 % and 4.41 % for K content in soil as affected by compost and bio-fertilizer application compared with control , respectively. These results are in agreement with Nasef *et al.,* (2009) who found that the mean values of available N, P and K content in soil increased significantly with addition of compost and bio-fertilizer combined with 50 % mineral N fertilizer. Mustafa *et al.,* (2006) indicated that available phosphate in soil was significantly increased by seed inoculation with bio-fertilizer. Shaban and Attia (2009) suggested that available N, P and K were significantly increased in soils treated with Bio- fertilizer in combination with chemical fertilizers,as compared to soils treated with chemical fertilizers.

Micronutrients content in the studied soil.

Data presented in Table (5) show that there is an increase in soil content (mg kg^{-1}) of available micronutrients (Fe, Mn and Zn) which achieved as a result of the used fertilizers addition. The high increase was from additions of compost or bio fertilizer with raised bed cultivation method, may be due to the increase of soil organic matter as a result of adding compost or bio-fertilizer. The effect of different fertilizers and cultivation methods and interaction between fertilizer sources and cultivation methods on available Fe and Mn content in soil were no significantly, while the available of Mn was significant as affected by cultivation methods. The variation in the contents of micronutrients may be due to the fertilization with bio-fertilizer and organic matter as reported by Abou El-Roos *et al.,* (1996), Abd El- Naim (1996) and Poraas *et al.,* (2009). The soil treated with bio-fertilizer in the raised bed planting indicated that this method improved soil microbial activities than flat planting. Higher bacteria/fungi ratios in raised-bed planting relative to flat are indicative of improved availability of nutrients (Gilliam *et al.,* 2011).

In general, it may be concluded that compost or bio-fertilizer applications decreased soil pH and EC but increased soil organic matter, cation exchange capacity and the contents of N, P, K, Fe, Mn and Zn. Hence, there was a general increase in nutrient supplying capacity of soils.

Table (5): Available content of macro and micronutrients in the studied soil after wheat harvest (Average of two seasons)

Method of sowing	Treatments of fertilization	Available nutrients (mg kg^{-1} soil)					
		N	P	K	Fe	Zn	Mn
Flat	Control (100kg N fed^{-1})	47.01	5.23	204	2.87	0.80	1.79
	Compost + 75 kg N fed^{-1}	53.25	5.93	212	2.95	0.82	1.83
	Biofertilizer75 kg N fed^{-1}	50.20	6.15	210	2.92	0.84	1.80
Mean		50.15	5.77	209	2.91	0.82	1.81
Raised bed	Control (100kg N fed^{-1})	47.10	5.95	205	2.89	0.81	1.82
	Compost + 75 kg N fed^{-1}	55.85	6.85	217	3.07	0.84	1.95
	Biofertilizer75 kg N fed^{-1}	54.63	7.33	216	3.09	0.89	1.93
Mean		52.53	6.71	213	3.02	0.85	1.90
Row	Control (100kg N fed^{-1})	48.25	5.73	204	2.88	0.79	1.79
	Compost + 75 kg N fed^{-1}	53.71	6.64	214	2.97	0.82	1.89
	Biofertilizer75 kg N fed^{-1}	52.62	7.02	212	2.95	0.86	1.85
Mean		51.53	6.46	210	2.93	0.82	1.84
Mean Control		47.45	5.64	204	2.88	0.80	1.80
Mean Compost		54.27	6.47	214	3.00	0.83	1.89
Mean biofertilizer		52.48	6.83	213	2.99	0.86	1.86
LSD 5% fertilizer		2.80	0.33	2.63	ns	ns	ns
LSD 5% methods		ns	0.44	ns	ns	0.036	ns
Fert X Meth		ns	ns	ns	ns	ns	ns

Effect of the studied treatments on macronutrient content in Wheat grains:

Data presented in Table (6) illustrate that the nitrogen concentration (%) in wheat grains increased with all treatments of compost or bio-fertilizer compared to control (N- mineral fertilizer). The highest value N percentage in grains was 2.25 % attained by treatment of compost with raised bed cultivation method. The effect of different fertilizers sources on N , P and K concentration in wheat grains were significantly , while the effect of different cultivation methods on N and K concentration in wheat grains were significant than P was no significant. As well as the N and K concentration in grains was no significantly as affected by interaction between different fertilizers applied and different cultivation methods system, while K was significant. The corresponding, relative increases of mean values N, P and K (%) concentration in wheat grains were 5.88 % and 1.47 % for N; 9.52 % and 7.14 % for P and 2.23 % and 3.00 % for K as affected by cultivation methods raised bed and row compared with flat, respectively. Also, the relative increase of mean values N, P and K concentrations in wheat grains as affected by different fertilizes were 8.54 % and 6.03 % for N ; 17.95 % and 25.64 % for P and 3.38 % and 4.13 % for K concentration in grains of wheat plant as affected by compost and bio-fertilizer compared with control (mineral nitrogen fertilizer), respectively .

Table (6): Macro and micro nutrient concentration of wheat grains (Average of two seasons).

Method of sowing	Treatments of fertilization	Macronutrients (%)			Micronutrients (mg/kg)		
		N	P	K	Fe	Zn	Mn
Flat	Control (100kg N fed^{-1})	1.95	0.39	2.66	89.42	18.20	58.8
	Compost + 75 kg N fed^{-1}	2.09	0.43	2.70	93.58	23.01	63.2
	Biofertilizer75 kg N fed^{-1}	2.04	0.47	2.70	92.70	25.58	65.4
Mean		2.04	0.42	2.68	91.90	22.26	62.47
Raised bed	Control (100kg N fed^{-1})	2.03	0.41	2.66	90.48	20.00	68.8
	Compost + 75 kg N fed^{-1}	2.25	0.47	2.76	96.81	30.75	79.5
	Biofertilizer75 kg N fed^{-1}	2.20	0.50	2.80	93.40	27.33	77.9
Mean		2.16	0.46	2.74	93.56	26.03	75.40
Row	Control (100kg N fed^{-1})	1.98	0.38	2. 68	90.55	20.09	65.5
	Compost + 75 kg N fed^{-1}	2.14	0.48	2.78	94.99	25.00	75.0
	Biofertilizer75 kg N fed^{-1}	2.10	0.49	2.81	93.50	26.35	72.4
Mean		2.07	0.45	2.76	93.01	23.70	70.97
Mean Control		1.99	0.39	2.66	90.15	19.43	64.37
Mean Compost		2.16	0.46	2.75	95.13	26.25	72.57
Mean biofertilizer		2.11	0.49	2.77	93.20	26.42	71.90
LSD 5% fertilizer		0.06	0.03	0.041	1.92	ns	1.60
LSD 5% methods		0.07	ns	0.031	ns	ns	2.42
Fert X Meth		ns	ns	***	ns	ns	*

It is evident from the distribution pattern of N, P and K concentration in grains of wheat that it could be arranged according to their contents in the following order : Raised bed > row > flat for N and P in grains of wheat .

Row > raised bed > flat for K in grains of wheat. The relative increase of the studied N, P and K in grains of wheat are mainly depend on the used mineral N ; compost and bio-fertilizers , as it could be arranged as follows:

Compost > bio-fertilizer > N mineral for N. These results are in agreement by Moubarak, *et al.,* (2007) who reported that the contents of N, P and K in plant were significant higher with application of organic fertilizer compared with inorganic fertilizer. Abdullah, (2007) found that the application of compost increased the content of N, P and K in wheat yield compared with the use of chemical fertilizers. Shaban *et al.,* (2011) indicated that the maximum increase of N, P and K concentrations in grains were observed when compost was added at the rate of 10 tons fed^{-1} combination with 120 kg N fed^{-1}.

Bio-fertilizer > Compost > N mineral, for P and K. These results are in agreement by Salama (2006) who reported that the application of bio- fertilizers plus inorganic N- fertilizers increased the N, P and K content (mg/kg plant) in whole parts wheat compared with inoculated by bio- fertilizers. Massoud (1999) who found that P concentration increased with inoculation with (Azotobacter+ VAM) compared with control. These results agreed with data obtained by El-Sawah (2000) who found significant increase in N, P and K content of maize plant when seeds were inoculated with Azospirillum brasilens and Bacillus megatherium as well as low dose of mineral nitrogen fertilizers.

Micronutrients concentration in wheat grains.

Data presented in Table (6) show the effect of different fertilizers sources and different cultivation methods on micronutrients (Fe, Mn and Zn) (mg kg^{-1}) concentration in wheat grains were positive effect. The maximum values of Fe 96.81; Mn 79.50 and Zn 30.75 mg kg^{-1} contents in grains as affected soil by compost and cultivated with raised bed than other treatments. The effect of different fertilizers on Fe and Mn content in grains were significantly while the Zn concentration in grains was no significant. Concerning the effect of cultivation methods on Fe and Zn were no significantly, while the Mn was significant as affected by cultivation methods. The interaction between the tested fertilizers and cultivation methods were no significant for Fe and Zn, while the Mn contents in wheat grains was significant. The relative increase of mean values Fe, Mn and Zn concentration in wheat grains were 1.81 % and 1.21 % for Fe; 16.93 % and 6.47 % for Zn and 20.69 % and 13.61% for Mn respectively as affected by raised bed and row cultivation methods compared with flat method. On the other hand the relative increase of mean values Fe, Mn and Zn concentration in wheat grains as affected by different fertilizers were 5.52 % and 3.38% for Fe ; 32.53 % and 35.97 % for Zn and 12.73 % and 11.69 % for Mn as affected by compost and bio-fertilizer compared with control (mineral N), respectively. The relative increase of mean values Fe, Zn and Mn concentration in wheat grains were soil treated with raised bed method than row and flat cultivation methods. The utilization of compost led to increase of relative mean values of Fe and Mn content in grains of wheat, while the Zn was increase by using bio-fertilizer. These results are in agreement by Mohamed *et al.,* (2008) who found that the application of organic manure and bio-fertilizer (*Rhizobactrin*) led to increase the content of Fe, Mn, Zn and Cu in grains of maize. Uyanoz *et al.,* (2006) found that treating sandy clay loam soil with the organic materials increased Fe, Mn and Zn content in wheat grains compared with control. Ashmaye *et al.,* (2008) reported that application of bio-fertilizer or organic matter alone or combination with different rates of urea fertilizer led to increase for Fe, Mn and Zn contents in grains treated with organic matter + 85 kg N fed^{-1} and bio-fertilizer + 85 N kg Fed^{-1} .

Effect of all treatments on straw, grains yield and 1000 grains of wheat.

Data presented in Table (7) show that the effect of different cultivation methods on grains yield and straw yield (ton/fed) were no significant increase, while the weight of 1000 grain (g) was significantly increased as affected with different cultivation methods. On the other hand, the effect of different fertilizers on grains yield (ton/fed) and 1000 grains (g) were significant, while straw yield (ton/fed) was no significant. The interaction between different fertilizers and different cultivation methods on straw yield (ton/fed); grains yield (ton/fed) and weight of 1000 grains (g) were no significant affect. These results are in agreement by Wang *et al.,* (2004) who suggested that method raised bed planting system for maize production caused increase of maize yield region in China. Govaerts *et al.,* (2007) found that the important of raised bed planting method is it can increase yield by permitting farmers to grow more and superior crops.

Table (7): Straw and grain yields (ton/fed) of wheat plants and 1000 grains weight as affected by different fertilization treatments (Average of two seasons)

Method of sowing	Treatments of fertilization	Straw Ton/fed	Grains Ton/fed	Weight of 1000 grains (g)
Flat	Control (100kg N fed^{-1})	3.139	1.974	42.00
	Compost + 75 kg N fed^{-1}	3.156	2.257	44.59
	Biofertilizer+75 kg N fed^{-1}	3.144	2.249	48.20
Mean		3.146	2.160	44.93
Raised bed	Control (100kg N fed^{-1})	3.150	1.973	52.47
	Compost + 75 kg N fed^{-1}	3.255	2.307	55.69
	Biofertilizer+75 kg N fed^{-1}	3.246	2.301	58.61
Mean		3.217	2.194	55.59
Row	Control (100kg N fed^{-1})	3.147	1.970	45.88
	Compost + 75 kg N fed^{-1}	3.186	2.296	55.00
	Biofertilizer +75 kg N fed^{-1}	3.196	2.285	50.67
Mean		3.176	2.184	50.52
Mean Control		3.150	1.970	46.78
Mean Compost		3.200	2.290	50.32
Mean biofertilizer		3.195	2.280	53.94
LSD 5% fertilizer		ns	ns	7.02
LSD 5% methods		ns	0.03	2.13
Fert X Meth		ns	ns	ns

The relative increase of mean values straw yield (ton/fed); grains yield and 1000 grains (g) were 2.25 % and 1.00 % for straw yield ; 1.57 % and 1.11 % for grains yield and 23.72 % and 12.44 % for 1000 grain as soil treated by raised bed and row cultivation methods compared with flat method respectively. Data in Table (7) show that the increase of straw yield, grains yield and weight of 1000 grains in plot used raised bed followed by row than flat cultivation method. On the other hand the relative increase of mean values straw yield (ton/fed); grains yield and 1000 grains (g) were 1.58 % and 1.48 % for straw yield ; 16.24 % and 15.73 % for grains yield and 14.22% and 7.56 % for weight 1000 grains respectively , as affected by compost and bio-fertilizer compared with control. The obtained results might be due to the stimulation effect of compost and bio-fertilizer on improving, increasing soil fertility and increasing the availability of many nutrients to plant uptake, which in turn improves the yield and its components of wheat plants. These results are in harmony with those obtained by Badr *et al.,* (2009) and Wali Asal (2010).

Conclusion

Finally, it could be concluded that the data presented in this work demonstrated the great importance of the appropriate role of compost and bio-fertilizer improving soil characters and enhancing its productivity of wheat as well as promotes the concentration of N, P, K, Fe, Mn and Zn by grains of wheat plants under the conditions of saline soil and raised bed followed by row cultivation methods.

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تأثير التسميد العضوي والحيوي وطرق الزراعة على خواص الأرض الكيميائية وإنتاجية القمح في ارض ملحية

انشراح إبراهيم محمد المعاز ، هدى محمد رجائي محمود أحمد ، خالد عبده حسن احمد شعبان
معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية – الجيزة

الملخص العربى

أجريت تجربتان حقليتان في موسمي الشتاء ٢٠١١ /٢٠١٢ و٢٠١٢/٢٠١٣ في مزرعة خاصة بمنطقة سهل الطينة وكانت الأرض ملحية رملية طميية ؛ ذات ملوحة ١٢.٨٢ ملليموز /سم وذلك لدراسة مدى إمكانية زراعة القمح صنف (مصر٢) تحت ظروف الملوحة باستخدام طرق زراعة مختلفة وهى مصاطب وخطوط وأرض مستوية وكذلك استخدام أسمدة مختلفة وهى التسميد العضوي(الكمبوست) والحيوي و المعدني. وهذه المنطقة تروى بمياه ترعة السلام (المخلوطة بنسبة ١:١ مياه نيل + مياه صرف زراعي) .

وقد أوضحت النتائج المتحصل عليها ما يلى:

* انخفضت ملوحة التربة معنويا مع كل المعاملات وكانت المعاملة الأكثر تأثيرا على انخفاض ملوحة التربة هي التسميد الحيوى مع طريقة الزراعة على مصاطب مقارنة بالمعاملات الأخرى مع طرق الزراعة المختلفة.
* كان لكل المعاملات دور فى تقليل pH التربة وكان هذا التأثير أكثر وضوحا في المعاملة بالتسميد الحيوي مع طريقة الزراعة على مصاطب.
* زادت المادة العضوية و كذلك ازدادت قيم السعة التبادلية الكاتيونية وهذه النتيجة كانت واضحة تحت تأثير التسميد الحيوي يليها العضوي ثم المعدني تحت طرق زراعة المصاطب مقارنة بباقي المعاملات.
* أدى استخدام التسميد الحيوي والعضوي والمعدني إلى زيادة معنوية في العناصر الميسرة من النتروجين والفوسفور والبوتاسيوم في التربة بعد الحصاد وكذلك زاد محتوى العناصر الصغرى (الحديد والمنجنيز والزنك) الميسرة في كل المعاملات.
* أيضا زاد المحتوى العنصري للعناصر الكبرى النتروجين والفوسفور والبوتاسيوم في الحبوب لنبات القمح في المعاملات الحيوي والعضوي مقارنة بالتسميد المعدني .كما لوحظ أن هناك زيادة فى العناصر الصغرى الحديد و المنجنيز و الزنك وخاصة المعاملة بالتسميد الحيوي والعضوي .
* أظهرت النتائج أيضا زيادة فى محصول القمح فى جميع المعاملات وتحت ظروف الأراضي الملحية مقارنة بالكنترول وكان أعلى محصول من الحبوب و القش في معاملات الحيوي والعضوي مع طريقة الزراعة على خطوط مقارنة بباقي المعاملات. * وبصفة عامة توصى الدراسة باستخدام الحيوي والعضوي(الكمبوست) في التسميد و الزراعة على خطوط حيث يقلل من ملوحة التربة و يعمل على تحسين خواص التربة الكيميائية وزيادة المحتوى من العناصر الكبرى والصغرى وبالتالي زيادة المحصول مقارنة بالمعاملات الأخرى تحت الدراسة.