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EFFECT OF NITROGEN FERTILIZER AND COMPOST RATES ADDITION AT DIFFERENT DEPTHS ON SOME SOIL CHEMICAL PROPERTIES

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ABSTRACT

Two field experiments were conducted on clay loam soil during the two successive seasons, summer season 2017 using maize plants and winter season 2017/2018 using barley plants at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate to evaluate the direct and residual effects of compost rates mixed with the surface soil layer to 10 cm or added in 30 cm mole depth, arranged in parallel orientation with respect to one another and spaced at 3 m apart besides the nitrogen fertilizer rates on improving some soil chemical properties. Furthermore economical analysis was done by calculating the net income for every treatment to determine the economical treatment.

The rates of compost were 0.0, 2.5, 5.0 and 7.5 Ton fed-1, while the nitrogen rates were 0.0, 50, 75 and 100 % of the recommended dose for every growing crop. The experiments were conducted in a split-split plot in a randomized complete block design (RCBD) with three replicates.

All treatments slightly decreased the soil reaction (pH) in the two growing seasons. Soil salinity (EC), soluble cations and anions and total soluble salts (TSS) significantly increased by increasing nitrogen or compost rates and significantly decreased by increasing application depth. On the other hand, SAR values were significantly decreased with all treatments. All treatments led to significant increases in Ex. Ca, Mg, K and cation exchange capacity (CEC), whereas Ex. Na and ESP were significantly decreased with all treatments in the two seasons. All treatments clearly enhanced total nutrients (N. P and K) of the investigated soil. Also, Organic carbon (O.C, %) and C/N ratio were significantly increased with all treatments. According to the economical analysis, the application of 5 ton compost fed-1 in 30 cm mole depth with 100 % the recommended dose of nitrogen fertilizer for every crop was the best treatment compared with the other treatments and get a markedly improve in chemical properties which reflect on higher yield, since it gave the highest net income (16809.80 L.E fed-1).

Keywords: Moles, Compost, Soil chemical properties

INTRODUCTION

In the Middle Delta, at El-Gemmeiza Agricultural Research Station, the reduction in crop yields could possibly be ascribed to the soil compaction that can be induced by agro mechanical operations for long periods, **El-Maddah and El-Sodany (2003).** Also, they reported that the moles at 2, 4 and 6 m spacing in 30 and 60 cm depth clearly increased leaching the soluble salts and decreased EC and SAR values. Also, the crossed moles were better during the two seasons since they decreased EC, SAR and total soluble salts as compared with the achieved by parallel ones.

Improving the heavy clay compacted soils can be achived by drainage and sub-soiling technique. Mole drains are conveniently used in heavy soils. If no changes in management practices were made after mole drains the study soil were re-compacted within 3 years with the same or worse physical chemical properties and land qualities. The zones broken channels should be too narrow to prevent the re-compacted in a few years. On the other hand, drainage installation for leaching purpose will only be fully successful if they permit the uniform leaching of soluble salts from the whole soil profile.

El-Sabry et al (1992) found that the superiority of treatment was 3 m spacing compared with the other treatments (6, 8 and 12 m spacing). Furthermore all treatments increased leaching of soluble salts and decreased SAR values comparing with the control (without moling).

Abou El-Soud et al (1996) reported that the data obtained in all seasons under their study that installation of moles at 2, 4 and 6 m spacing decreased ECe values by 40.5, 41.1 and 33.0 % respectively comparing to the control. The crossed moles were better during all seasons since they decreased ECe by about 8.0 % as compared with that achieved by the parallel ones.

El-Sodany et al (2016) found that the use of compost rates at different depths in moles (20 and 40 cm) get a markedly improve in chemical properties which reflect on higher yield incorporated with high net income. Also, soil reaction (pH), SAR values were decreased by the addition of compost rates at different depths. While soil salinity (EC) and total soluble salts (TSS), soluble cations and anions, Organic carbon (O.C, %) and C/N ratio were increased.

Moreover, most of the cultivated soils in our country have organic matter far way below a good agricultural soil that should contain at least 2% organic matter. So, when compost is applied to the soil, it can support plant growth and enhance plant yield as well as improve the physical, chemical and biological properties of soils **(Convertini et al 2004)**.

Eghball et al (2004) found that the residual effects of manure and compost applications significantly increased soil electrical conductivity and pH levels. **Saraiya et al (2005)** showed that the application of compost prepared from rice residue to wheat increased organic carbon content. **El-hady and Abo-Sedera (2006)** reported that the soil conditioning positively effect chemical and biological properties of the soil these effects are assembled in the following: (a) slightly decreasing soil pH, (b) increasing both CEC of the soil and its specific surface area indicating an improvement in activating chemical reactions in the soil, (c) increasing OM, organic carbon, total nitrogen % in the soil, Because the increase in total nitrogen is higher than that in organic carbon, narrower C/N ratio of treated soils were obtained indicating the mineralization of organic nitrogen compounds and hence the possibility to save and provide available forms of N to growing plants, (d) increasing N, P and K in treated soil.

El-Maddah et al (2012) found that all soil conditioners slightly decreased the soil reaction (pH), Ex. Na and ESP and increase soil salinity, Ex. Ca, Mg and cation exchange capacity (CEC), Organic carbon (O.C, %), C/N ratio, available NPK and soil extractable metals (Fe, Zn, Mn and Cu). Also, **El-Sodany and El-Maddah (2009)** reported that the use of organic matter lead to a slightly decreases in soil reaction (pH) and progressive increases in soil salinity (EC), soluble ions (Ca, Mg, Na, HCO3, Cl and SO4), total soluble salts (TSS) and sodium adsorption ratio (SAR). **El-Shouny (2006)** reported that the addition of different rates of soil amendments, i.e., FYM and sulphur to clay soil at Kafer El-Shiekh Governorate decreased pH and ESP but increased the soluble cations and anions.

Abd-Allah (2014) showed that the natural soil amendments such as water hyacinth compost, rice straw compost and farmyard manure had a slightly decrease in soil pH and progressive increase in soil EC for the two soil depths in the two growing seasons. Also, soluble cations and anions slightly increased with all added treatments. SAR and TSS values were increased compared with the control. Exchangeable Ca, Mg, K and CEC were increased, while Ex. Na and ESP were decreased with all added amendments.

El-Maddah et al (2015) show that some natural soil amendments, i.e., farmyard manure, sheep manure, rabbit manure and pigeon manure and their combinations slightly decreased soil pH and progressive increased soil salinity (EC). Also, soluble cations and anions slightly increased except soluble Na decreased in some cases. SAR values were decreased while TSS values were increased compared with the control. Exchangeable Ca, Mg, K, CEC, organic carbon and C/N ratio were increased with all added amendments while Ex. Na and ESP were decreased. Also, these amendments clearly enhanced the nutrients of the investigated soil.

Amer (2016) referred that cation exchange capacity was highly significant increased due to individual application of biochar, compost tea, or magnetic iron ore and recorded the highest values by combination of treatments after harvesting of plant. **Gayathri and Srinivasamurthy (2016)** indicate that higher NPK content and higher root, shoot, dry weight in soil after harvest of maize were recorded of humic acid sources extracted from different organic wastes (poultry manure, pressmud, coffee pulp and urban compost) and lower nutrient content in soil was recorded in only NPK treated soils. **Guo et al (2016)** demonstrated that organic matter and total N content from topsoil were significantly and positively related to cattle manure compost (CMC) input. Applying chemical fertilizers led to the lower SOM and total N content. **Agegnehu et al (2016)** found that organic amendments significantly improved soil properties through increases in soil organic carbon (SOC), cation exchange capacity (CEC). The use of biochar, compost or compost + biochar may substantially reduce the amount of mineral fertilizer required for the sustainable production of barley in the long term. **Meena et al (2015)** indicated the higher value of organic carbon was observed in farmyard manure applied equivalent to 120 kg N/ha followed by vermicompost equivalent to 120 kg N/ha.

Wapa and Oyetola (2014) found that the major soil chemical properties affected by the combined application of nitrogen fertilizer and different organic manures include soil pH, CEC, soil organic carbon, total nitrogen and C/N ratio. There was significant decrease in soil pH, soil CEC and C: N ratio as nitrogen fertilizer was applied in combination with poultry droppings in 2008 and 2009 and in the combined analysis. While, there was a significant increased in soil organic carbon content, total nitrogen contents with the addition of nitrogen fertilizer application in combination with cow dung in 2008 and 2009 and in the combined analysis. **Zhong et al (2014)** indicated that the soil pH values were decreased with more N application at different stages. N application could increase the N contents of leaf and stem, whereas less or excess N application should not significant improve maize yield. Reasonable N fertilizer amount (241.5 kg/ha) and application at two stages (30% at sowing and 70% at jointing stage) could significant increase N utilization efficiency and improve maize yield.

The purpose of this work is to find out the direct and residual effects of compost rates at 30 cm mole depth, arranged in parallel orientation with respect to one another's at 3 m spacing or placed on the surface layer with nitrogen fertilizer rates on improving some soil chemical properties. Furthermore, the whole improvements of such soils are economically determined by calculating the net income for all treatments.

MATERIALS AND METHODS

Two field experiments were conducted at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate during two consecutive growing seasons (summer season 2017 and winter season 2017/2018). The experiment was initiated in summer season 2017 using maize plants (Zea mays) and lasted for winter season 2017/2018 using barley plants (Hordum vulgare) to study the effect and residual effects of nitrogen fertilizer and compost rates at 30 cm mole depth arranged in parallel orientation with respect to one another and spaced at 3 m aparts or mixed to 10 cm of surface soil layer on improving some soil chemical properties and some macronutrients content. Some soil properties of the experimental soil are presented in **Table (1-a)** and the used compost analysis are shown in **Table (1-b).**

The experimental design was split-split plot with three replications. The main plots were for two application depths of compost, D1 (Surface application ≈ 10 cm depth) and D2 (30 cm mole depth), sub plots were for nitrogen fertilizer rates (N1 = zero %, N2 = 50 %, N3 = 75 % and N4 = 100 % of recommended dose for each crop) and sub-sub plots were for compost rates (C1 = zero, C2 = 2.5, C3 = 5.0 and C4 = 7.5 ton fed^{-1}). The plot area of the experiment was 24 m^2 (4 m × 6 m) where the area of the experiment was divided into 32 plots for each replicate.

The moles were constructed at 30 cm depth by special ditcher, then the compost was placed on the soil surface or filled moles manual. The addition of compost were done before maize sowing in the first season only and the residual effect of compost was studied on barley crop in the second one, where the same experimental plots were left without application of compost to study the residual effects in the first season.

Maize grains (*Zea mays L.*) single cross 10 maize hybrid were planted **(Summer 2017)** at the rate of 10 kg fed^{-1} during the first week of June 2017. While, barley grains (*Hordum vulgare L.*) cultivar Giza 126 were planted in the second season at the rate of 50 kg fed^{-1} during the third week of December 2017.

During the two seasons, the basal doses of P in the form of mono supper phosphate, 15.5 % P_2O_5 and K in the form of potassium sulphate, 48 % K_2O were applied according to the recommendations for each crop, 31 Kg P_2O_5 fed^{-1} and 48 Kg K_2O fed^{-1}, for maize and 15.5 Kg P_2O_5 fed^{-1} and 24 Kg K_2O fed^{-1} for barley. While, the recommended dose of N fertilizer, 120 Kg N fed^{-1} for maize and 45 Kg N fed^{-1} for barley, were applied in the form of ammonium nitrate, 33.5 % N. The normal agricultural practices except those under study were carried out as usual for each crop according to the recommendations of El-Gemmeiza Research Station.

Table 1-a. Some soil properties of the experimental site

Soil depth, cm		0-10	10-30	Soil depth, cm		0-10	10-30
Physical properties							
Particle size distribution				**Texture class**		**Clay loam**	**Clay loam**
Coarse sand, %		5.17	4.65	Bulk density (Db, g cm^{-3})		1.38	1.41
Fine sand, %		19.77	19.81	Total porosity (E, %)		47.92	46.79
Silt, %		36.96	35.93	Hydraulic conductivity (Kh, cm hr^{-1})		0.47	0.44
Clay, %		38.10	39.61	$CaCO_3$, %		3.44	3.32
Chemical properties							
pH, 1:2.5 (susp.)		7.76	7.78	Exchangeable cations, meq/100g soil	Ca	21.21	20.28
EC, dSm^{-1}		1.70	1.73		Mg	14.83	14.38
Soluble ions, meq l^{-1}	Ca^{2+}	5.10	5.03		Na	5.95	5.84
	Mg^{2+}	3.77	3.42		K	0.64	1.04
	Na^{+}	8.53	8.87	CEC, meq/100g soil		42.63	41.54
	K^{+}	0.11	0.08	ESP, %		13.96	14.06
	CO_3^{2-}	0.00	0.00	Total macronutrients, %	N	0.137	0.127
	HCO^{3-}	2.30	2.45		P	0.031	0.029
	Cl^{-}	7.86	7.91		K	0.317	0.304
	SO_4^{2-}	6.84	6.94	Organic matter (O.M, %)		2.53	2.25
SAR		4.17	4.34	Organic carbon (O.C, %)		1.465	1.304
TSS, %		0.08	0.08	C / N ratio		10.69	10.27

Table 1-b. Some chemical characteristics of the investigated compost

Properties	Compost	Properties	Compost
pH (1:10 compost: water)	7.39	Bulk density, g/cm^3	0.57
EC, dS m^{-1}(1:10 manure:water)	3.19	Moisture content, %	18.00
Ca, %	0.84	Ash, %	66.33
Mg, %	0.29	Organic matter, %	33.67
Na, %	0.27	Organic carbon, %	19.53
Cl, %	0.14	Total N, %	1.57
Fe, ppm	1215.00	C/N ratio	12.44
Zn, ppm	83.15	Total P, %	0.95
Mn, ppm	72.80	Total K, %	1.6
Cu, ppm	31.25		

The compost was placed and mixed with surface soil layer by chisel plow (9 shares) two passes at an average depth of 10 cm and underground moles 3 m spacing at 30 cm depth, with rate of 0.0, 2.5, 5.0 and 7.5 ton fed^{-1} before sowing.

At harvesting of each growing season, soil samples (10 and 30 cm depths) were collected after crop harvesting. The collected soil samples were air-dried, ground and passed through 2 mm sieve and stored for chemical analysis.

Soil pH in soil water suspension (1: 2.5) and soil electrical conductivity (EC, dSm^{-1}) in soil paste extract were measured. Soluble cations and anions were determined in soil paste extract using the methods described by **Page *et al.* (1982).**

Sodium Adsorption Ratio (SAR) was calculated as:

$$SAR = \frac{Na\ meq/l}{\sqrt{\frac{Ca + Mg\ meq/l}{2}}}$$

Total soluble salts, % were calculated according to the following equation:

$$\text{T.S.S., \%} = \frac{EC\ dSm^{-1} \times 0.064 \times SP}{100}$$

Where: SP = Saturation percentage

Cation exchange capacity (CEC, meq/100g soil) was determined using sodium acetate solution 1.0 N with pH 8.2, exchangeable cations (meq/100g soil) were displaced using 1.0 N ammonium acetate solution. Exchangeable sodium percentage (ESP, %) was calculated according to the following equation :

$$ESP,\ \% = \frac{Ex.\ Na\ meq/100g.soil}{CEC\ meq/100g.soil} \times 100$$

Organic matter was determined by Walkely and Black method according to **Black (1965).** Total NPK of the soil were determined according to **Hesse (1971).** Total nitrogen by macro-Kjeldahel method, total phosphorus by ascorbic acid molybdenum blue method and total potassium by flame photometer method.

Economic evaluation was done to compare between different treatments to state which one is more reliable. The test was executed according to the price of the yield (2000 L.E. ton^{-1} maize in the first season and 4000 L.E. ton^{-1} seed of barley and 1000 L.E. ton^{-1} straw of barley in the second season), as well as the cost of different treatments including the price of plowing which was calculated considering conventional method of estimating both fixed and variable costs. The collected data were statistically analyzed according to procedure out lined by **Sendecor and Cochran (1981)**.

RESULTS AND DISCUSSION

I- Effect of different treatments on some soil chemical properties

1- Soil reaction (pH)

The effect of compost rates filled 30 cm mole depth or placed on the surface soil layer with nitrogen fertilizer rates on soil reaction (pH) are shown in **Tables (2 and 3)**. The results indicate that, all different treatments led to slightly decreases in soil pH for the two growing seasons. The lowest pH value was obtained by the addition of 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, which decreased to 7.12 and 7.08 in the first and second seasons, respectively. These results reveal that the decrease in soil pH values may have been caused by soil microbial activity that produced CO2 and organic acids. Modification of soil pH is more important because microbial activity decreases blow 6 or increases above 7 (**Mohammad and Battikhi, 1997**). Similar conclusion was obtained by **El-Sodany et al (2007)**, they showed that the organic residues filled moles at different depths slightly decrease the soil reaction (pH).

The results also reveal that the application depth was significantly decrease soil pH, where the use of 30 cm mole depth (D2) decreased it more than surface depth (D1). The decreases of soil pH mean values reached to 7.39 and 7.34 at 30 cm mole depth, while the surface depth reached to 7.43 and 7.38 in the first and second seasons, respectively. This reduction may be due to the fact that the mole drains allow water and organic acids resulted from organic matter decomposition to percolate and downward taking them to deeper layer of soil. Similar results was obtained by **El-Maddah et al (2007).**

The results from these tables show that increasing nitrogen fertilizer rates gave significant decreases in soil pH, where the lowest pH mean value was recorded by the addition of 100 % of recommended dose nitrogen fertilizer for each crop under the experimental treatments, which decreased to 7.21 and 7.16 of the first and second seasons, respectively. These results may be due to by increasing N fertilizer rates the C/N ratio in soil became narrow which led to accelerate the decomposition of organic substances causing decreases in soil pH. These results are in line with **Wapa and Oyetola (2014)** and **Zhong et al (2014)**.

Also, the results show that the addition of compost rates obtained significant decreases in soil pH. The lowest pH mean value was recorded by the addition of 7.5 ton compost fed^{-1}, which decreased to 7.35 and 7.30 of the first and second seasons, respectively. These results reveal that there is no wide variation between these added treatments on soil pH values. This may be due to the magnitude of pH change depends on many soil properties, including buffering capacity and length of time after the application organic material. Modification of soil pH is also important because trace metals became more plant available as the pH decreases. In addition, microbial activity decreases as the pH decreases below 6 or increases above 7. Similar conclusion was obtained by **El-Shouny (2006)**, who reported that application of different rates of soil amendments, i.e., FYM and sulphur to clay soil at kafer El-Shiekh Governorate decreased pH. These results are also in line with **El-Maddah et al (2012) and El-Sodany et al (2016).**

Table 2. Effect of different treatments on some soil chemical properties after maize in the first season (summer 2017)

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed^{-1})	pH, 1:2.5 (susp.)	EC, dSm^{-1}	Cations, meq l^{-1}				Anions, meq l^{-1}			SAR	TSS, %
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}		
D1	N1	C1	7.75	1.68	5.06	3.18	8.45	0.11	2.25	7.81	6.74	4.16	0.08
		C2	7.63	1.92	5.64	4.30	9.04	0.22	2.95	9.03	7.22	4.05	0.10
		C3	7.61	1.94	5.78	4.33	9.06	0.23	2.99	9.12	7.29	4.03	0.10
		C4	7.59	1.97	5.84	4.53	9.10	0.23	3.04	9.33	7.33	4.00	0.10
	N2	C1	7.65	2.03	5.93	4.92	9.31	0.14	3.01	9.43	7.86	4.00	0.10
		C2	7.44	2.12	6.33	5.23	9.41	0.23	3.25	9.97	7.98	3.91	0.11
		C3	7.43	2.17	6.53	5.47	9.46	0.24	3.28	10.37	8.05	3.86	0.11
		C4	7.42	2.19	6.55	5.61	9.49	0.25	3.30	10.44	8.16	3.85	0.12
	N3	C1	7.47	2.09	6.23	5.12	9.33	0.22	3.11	9.80	7.99	3.92	0.10
		C2	7.32	2.25	6.97	5.72	9.56	0.25	3.32	10.52	8.66	3.80	0.11
		C3	7.31	2.28	7.09	5.84	9.61	0.26	3.38	10.65	8.77	3.78	0.12
		C4	7.30	2.29	7.12	5.89	9.62	0.27	3.41	10.70	8.79	3.77	0.12
	N4	C1	7.35	2.37	7.39	6.30	9.71	0.30	3.20	11.46	9.04	3.71	0.11
		C2	7.19	2.51	8.23	6.55	9.95	0.37	4.61	11.72	8.77	3.66	0.12
		C3	7.18	2.66	8.89	7.16	10.17	0.38	4.78	12.14	9.68	3.59	0.14
		C4	7.17	2.89	10.00	8.20	10.31	0.39	4.86	12.40	11.64	3.42	0.15
D2	N1	C1	7.73	1.64	4.69	3.27	8.37	0.07	2.23	7.61	6.56	4.20	0.08
		C2	7.57	1.69	4.89	3.40	8.45	0.16	2.31	7.72	6.87	4.15	0.09
		C3	7.55	1.72	5.04	3.51	8.48	0.17	2.42	7.86	6.92	4.10	0.09
		C4	7.54	1.75	5.13	3.71	8.49	0.17	2.55	7.91	7.04	4.04	0.10
	N2	C1	7.58	1.86	5.60	4.27	8.57	0.16	2.57	8.86	7.17	3.86	0.09
		C2	7.41	2.11	6.57	5.27	9.05	0.21	2.96	10.35	7.79	3.72	0.11
		C3	7.40	2.12	6.59	5.34	9.06	0.21	2.98	10.40	7.82	3.71	0.11
		C4	7.39	2.14	6.66	5.45	9.08	0.21	3.02	10.52	7.86	3.69	0.12
	N3	C1	7.46	1.91	5.79	4.45	8.67	0.19	2.80	9.11	7.19	3.83	0.09
		C2	7.28	1.97	6.15	4.51	8.78	0.26	2.85	9.55	7.30	3.80	0.10
		C3	7.27	1.98	6.18	4.55	8.79	0.28	2.87	9.61	7.32	3.79	0.11
		C4	7.26	2.00	6.26	4.64	8.81	0.29	2.90	9.68	7.42	3.77	0.11
	N4	C1	7.34	2.25	7.20	5.80	9.25	0.25	3.30	11.00	8.20	3.63	0.11
		C2	7.15	2.26	7.24	5.84	9.26	0.26	3.34	11.04	8.22	3.62	0.12
		C3	7.14	2.32	7.43	6.11	9.34	0.32	3.63	11.24	8.33	3.59	0.13
		C4	7.12	2.37	7.65	6.34	9.39	0.32	3.86	11.34	8.50	3.55	0.13
A Application depth cm	D1 (surface)		7.43	2.21	6.85	5.52	9.47	0.26	3.42	10.31	8.37	3.84	0.11
	D2 (30 cm)		7.39	2.01	6.19	4.78	8.87	0.22	2.91	9.61	7.53	3.82	0.11
	F - test		**	*								**	**
B Nitrogen fertilizer	N1 (0%)		7.62	1.79	5.26	3.78	8.68	0.17	2.59	8.30	7.00	4.09	0.09
	N2 (50%)		7.47	2.09	6.35	5.20	9.18	0.21	3.05	10.04	7.84	3.83	0.11
	N3 (75%)		7.33	2.10	6.47	5.09	9.15	0.25	3.08	9.95	7.93	3.81	0.11
	N4 (100%)		7.21	2.45	8.00	6.54	9.67	0.32	3.95	11.54	9.05	3.60	0.13
	F - test		**	**								**	**
C Compost rates (ton)	C1 (0)		7.54	1.98	5.99	4.66	8.96	0.18	2.81	9.39	7.59	3.91	0.10
	C2 (2.5)		7.37	2.10	6.50	5.10	9.19	0.25	3.20	9.99	7.85	3.84	0.11
	C3 (5)		7.36	2.15	6.69	5.29	9.25	0.26	3.29	10.17	8.02	3.81	0.11
	C4 (7.5)		7.35	2.20	6.90	5.55	9.29	0.27	3.37	10.29	8.34	3.76	0.12
	F - test		**	**								*	**

2- Soil salinity (EC) and soluble ions

Data in **Tables (2 and 3)** show that all different treatments caused a significant affects on soil EC values. The highest values were obtained by the addition of 7.5 ton compost fed^{-1} in 10 cm depth with 100 % recommended dose of nitrogen fertilizer for each crop, where it increased to 2.89 and 2.95 dSm^{-1} in the first and second seasons, respectively as compared with other treatments. Similar results were obtained by **Eghball et al (2004)**. These results reveal that the highest values of soil EC may be due to the addition of nitrogen fertilizer or compost, where the EC values were decreased with increasing depth to 30 cm. Similar conclusion was obtained by **El-Maddah and El-Sodany (2003)**.

Table 3. Effect of different treatments on some soil chemical properties after barley in the second season (winter 2017/2018)

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed^{-1})	pH, 1:2.5 (susp.)	EC, dSm^{-1}	Cations, meq l^{-1}				Anions, meq l^{-1}			SAR	TSS, %
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^{--}		
D1	N1	C1	7.74	1.73	4.44	3.29	9.48	0.09	2.54	8.01	6.75	4.82	0.08
		C2	7.58	2.10	5.76	4.66	10.43	0.15	3.93	9.49	7.58	4.57	0.11
		C3	7.56	2.14	5.91	4.88	10.45	0.16	3.96	9.80	7.64	4.50	0.11
		C4	7.54	2.16	5.97	4.97	10.49	0.17	3.99	9.91	7.70	4.49	0.12
	N2	C1	7.59	2.24	6.02	4.99	11.19	0.20	3.71	10.37	8.32	4.77	0.11
		C2	7.39	2.37	6.50	5.65	11.25	0.30	4.20	11.05	8.45	4.56	0.12
		C3	7.38	2.39	6.64	5.67	11.27	0.32	4.23	11.18	8.49	4.54	0.13
		C4	7.37	2.43	6.84	5.77	11.36	0.33	4.26	11.33	8.71	4.52	0.13
	N3	C1	7.42	2.26	6.13	5.09	11.24	0.14	4.08	10.46	8.06	4.75	0.11
		C2	7.27	2.46	7.30	5.69	11.35	0.26	4.73	11.46	8.41	4.45	0.12
		C3	7.26	2.47	7.34	5.73	11.36	0.27	4.78	11.48	8.44	4.44	0.13
		C4	7.25	2.50	7.49	5.84	11.39	0.28	4.89	11.58	8.53	4.41	0.14
	N4	C1	7.30	2.57	7.71	6.41	11.29	0.29	4.39	12.02	9.29	4.25	0.13
		C2	7.15	2.78	8.44	7.58	11.41	0.37	5.12	12.99	9.69	4.03	0.14
		C3	7.14	2.87	8.86	7.94	11.52	0.38	5.14	13.31	10.25	3.97	0.15
		C4	7.13	2.95	9.13	8.38	11.60	0.39	5.18	13.39	10.93	3.92	0.16
D2	N1	C1	7.68	1.63	4.17	2.94	9.14	0.05	2.17	7.74	6.39	4.85	0.08
		C2	7.51	1.81	4.97	3.50	9.56	0.07	2.74	8.49	6.87	4.65	0.09
		C3	7.50	1.83	4.98	3.62	9.63	0.07	2.80	8.55	6.95	4.64	0.10
		C4	7.48	1.88	5.14	3.91	9.67	0.08	2.92	8.87	7.01	4.55	0.10
	N2	C1	7.52	2.07	5.95	4.28	10.33	0.14	2.76	10.02	7.92	4.57	0.10
		C2	7.36	2.12	6.07	4.48	10.43	0.22	3.07	10.14	7.99	4.54	0.11
		C3	7.35	2.15	6.15	4.62	10.48	0.25	3.09	10.32	8.09	4.52	0.12
		C4	7.34	2.17	6.15	4.75	10.54	0.26	3.15	10.40	8.15	4.51	0.12
	N3	C1	7.41	2.08	6.05	4.32	10.37	0.06	2.78	10.06	7.96	4.55	0.10
		C2	7.24	2.24	6.47	4.96	10.79	0.18	3.40	10.80	8.20	4.51	0.12
		C3	7.23	2.27	6.63	5.03	10.85	0.19	3.44	10.95	8.31	4.49	0.12
		C4	7.22	2.29	6.71	5.11	10.88	0.20	3.46	11.11	8.33	4.48	0.13
	N4	C1	7.29	2.40	7.37	5.93	10.48	0.22	3.45	11.64	8.91	4.06	0.12
		C2	7.11	2.48	7.47	6.54	10.50	0.29	3.71	12.14	8.95	3.97	0.13
		C3	7.10	2.53	7.70	6.77	10.53	0.30	3.88	12.39	9.03	3.91	0.14
		C4	7.08	2.56	7.87	6.86	10.56	0.31	4.03	12.43	9.14	3.89	0.14
A Application depth cm	D1 (surface)		7.38	2.40	6.91	5.78	11.07	0.26	4.32	11.11	8.58	4.44	0.12
	D2 (30 cm)		7.34	2.16	6.24	4.85	10.30	0.18	3.18	10.38	8.01	4.42	0.11
	F - test		**	**								**	*
B Nitrogen fertilizer	N1 (0%)		7.57	1.91	5.17	3.97	9.86	0.11	3.13	8.86	7.11	4.63	0.10
	N2 (50%)		7.41	2.24	6.29	5.03	10.86	0.25	3.56	10.60	8.27	4.57	0.12
	N3 (75%)		7.29	2.32	6.77	5.22	11.03	0.20	3.95	10.99	8.28	4.51	0.12
	N4 (100%)		7.16	2.64	8.07	7.05	10.99	0.32	4.36	12.54	9.52	4.00	0.14
	F - test		**	**								**	**
C Compost rates (ton)	C1 (0)		7.49	2.12	5.98	4.66	10.44	0.15	3.24	10.04	7.95	4.58	0.10
	C2 (2.5)		7.33	2.30	6.62	5.38	10.72	0.23	3.86	10.82	8.27	4.41	0.12
	C3 (5)		7.32	2.33	6.78	5.53	10.76	0.24	3.92	11.00	8.40	4.38	0.13
	C4 (7.5)		7.30	2.37	6.91	5.70	10.81	0.25	3.99	11.13	8.56	4.35	0.13
	F - test		**	**								**	**

The results indicate that the increasing of application depth led to significantly decreases on EC values as compared with the surface depth, where the use of 30 cm mole depth was more effective on decreasing EC values than 10 cm surface depth. The lowest EC values were obtained by the use of 30 cm mole depth (D2) compared with surface depth (D1), where the EC mean values were decreased from 2.21 to 2.01 dSm^{-1} in the first season and from 2.40 to 2.16 dSm^{-1} in the second one, respectively. Similar conclusion was obtained by **El-Sodany et al (2016).**

Regarding the effect of nitrogen fertilizer rates, data indicate that soil EC values were significantly increased by increasing the addition of nitrogen fertilizer, where the highest EC values were obtained by the addition of 100 % recommended dose of nitrogen fertilizer for each crop. The highest EC mean values were reached to 2.45 and 2.64 dSm^{-1} in the first and second seasons, respectively.

Also, the effect of compost rates were presented in Tables (2 and 3), the results reveal that soil EC values were significantly increased by increasing the compost rates addition. The highest EC mean values were recorded by the addition of 7.5 ton compost fed^{-1}, which it increased to 2.20 and 2.37 dSm^{-1} in the first and second seasons, respectively. These results are in agreement with that obtained by **El-Sodany and El-Maddah (2009) and El-Sodany et al (2016)**

Concerning the soluble ions, the results in **Tables (2 and 3)** show that the soluble ions, i.e., calcium, magnesium, sodium, potassium, bicarbonate, chloride and sulphate increased with all different treatments, which take the same trend as soil EC values. After harvesting of the first growing season, the increases of soluble Ca, Mg, Na, K, HCO_3, Cl and SO_4 were reached to 10.00, 8.20, 10.31, 0.39, 4.86, 12.40 and 11.64 meq l^{-1}, and reached to 9.13, 8.38, 11.60, 0.39, 5.18, 13.39 and 10.93 meq l^{-1} after harvesting of the second growing season, under D1 and application of N4 and C4 treatments.

The results revealed that the application depth led to decreases in soluble ions. The lowest mean values of soluble Ca, Mg, Na, K, HCO_3, Cl and SO_4 were recorded at 30 cm mole depth, where decreased to 6.19, 4.78, 8.87, 0.22, 2.91, 9.61 and 7.53 meq l^{-1} in the first season and decreased to 6.24, 4.85, 10.30, 0.18, 3.18, 10.38 and 8.01 meq l^{-1} in the second one, respectively. On the other hand, the results show that the increases of nitrogen fertilizer rates were increased soluble ions, where the highest values were recorded by the addition of 100 % recommended dose of nitrogen fertilizer for each crop. The highest mean values of soluble Ca, Mg, Na, K, HCO_3, Cl and SO_4 were increased to 8.00, 6.54, 9.67, 0.32, 3.95, 11.54 and 9.05 meq l^{-1} in the first season and increased to 8.07, 7.05, 10.99, 0.32, 4.36, 12.54 and 9.52 meq l^{-1} in the second one, respectively.

Likewise, the results clear that the increases of compost rates addition were increased soluble ions, where the highest mean values of soluble Ca, Mg, Na, K, HCO_3, Cl and SO_4 were recorded by the addition of 7.5 ton compost fed^{-1}, where they increased to 6.90, 5.55, 9.29, 0.27, 3.37, 10.29 and 8.34 meq l^{-1} in the first season, and 6.91, 5.70, 10.81, 0.25, 3.99, 11.13 and 8.56 meq l^{-1} in the second one, respectively. It can be noticed that the higher mean values of the treated soil with compost at the end of the second season compared with the first one may be due to high residual effect of this compost in the second season. These results are in agreement with that obtained by **El-Shouny (2006**), **El-Maddah et al (2012) and El-Sodany et al (2016)**

3- Sodium adsorption ratio (SAR) and total soluble salts (TSS)

Data in **Tables (2 and 3)** show that sodium adsorption ratio (SAR) and total soluble salts (TSS) markedly affected by the addition of compost rates filled 30 cm mole depth with nitrogen fertilizer rates. The lowest values of SAR and the highest values of TSS were recorded by the addition of 7.5 ton compost fed^{-1} in surface layer (10 cm depth) with 100 % recommended dose of nitrogen fertilizer for each crop, where the SAR value decreased to 3.42 and 3.92, while, the TSS value increased to 0.15 and 0.16 %, in the first and second seasons, respectively.

Concerning the application depth, the results indicate that the increases of application depth led to significantly decreases of SAR and TSS values. The lowest values of SAR and TSS were recorded by using 30 cm mole depth, where the mean values of SAR were decreased to 3.82 and 4.42, also the mean values of TSS decreased to 0.11 % in the first and second seasons, respectively. Similar results were obtained by **El-Maddah and El-Sodany (2003)**

Concerning the effect of nitrogen fertilizer rates, data indicate that the SAR values were significantly decreased, while, the TSS values were significantly increased by increasing nitrogen fertilizer rates addition. The lowest values of SAR and the highest values of TSS were recorded by the addition of 100 % recommended dose of nitrogen fertilizer for each crop, where the mean values of SAR were decreased to

3.60 and 4.00, while the mean values of TSS were increased to 0.13 and 0.14 % in the first and second seasons, respectively.

Data presented in **Tables (2 and 3)** also indicated that the addition of compost rates caused significant decreases in SAR values and significant increases in TSS. The lowest values of SAR and the highest values of TSS were recorded by the addition of 7.5 ton compost fed^{-1}. The lowest mean values of SAR were decreased to 3.76 and 4.35, while the highest mean values of TSS was increased to 0.12 and 0.13 % in the first and second seasons, respectively. Similar results were obtained by **El-Maddah and El-Sodany (2003).**

II- Effect of different treatments on exchangeable cations, cation exchange capacity and exchangeable sodium percentage

1- Exchangeable cations (Ca, Mg and K) and cation exchange capacity

The results in **Table (4)** show that the exchangeable cations (Ca, Mg and K, meq/100g soil) and cation exchange capacity (CEC, meq/100g soil) were significantly affected by the addition of compost rates filled 30 cm mole depth with nitrogen fertilizer rates. The results indicate that the Ex. Ca, Mg, K and CEC were significantly increased with all different treatments, where the highest values were obtained by the addition of 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop. The increases of the Ex. Ca, Mg, K and CEC were reached to 21.66, 15.21, 0.89 and 43.38 meq/100g soil in the first season, and reached to 21.68, 15.24, 0.90 and 43.42 meq/100g soil in the second one, respectively. Similar conclusion was obtained by **El-Maddah *et al.* (2015) and Amer (2016)**.

Concerning the application depth, the results indicate that the Ex. Ca, Mg, K and CEC values were significantly increased by increasing the application depth as compared with the surface depth. The highest mean values of them were recorded by using 30 cm mole depth, where the values were reached to 21.49, 15.03, 0.81 and 43.07 meq/100g soil in the first season, while in the second one, they were reached to 21.51, 15.06, 0.83 and 43.11 meq/100g soil, respectively.

Data in **Table (4)** indicate that increasing nitrogen fertilizer rates led to significantly increases of the Ex. Ca, Mg, K and CEC values, where the highest values were obtained by the addition of 100 % recommended dose of nitrogen fertilizer for each crop. The highest mean values of Ex. Ca, Mg, K and CEC were 21.54, 15.09, 0.84 and 43.16 meq/100g in the first season, and were 21.57, 15.13, 0.85 and 43.22 meq/100g soil in the second one, respectively. These results may be due to accelerating of organic materials decomposition resulting increases in CEC and ex. cations in soil. Similar results were obtained by **Abd-Allah (2014)** and **Wapa and Oyetola (2014)**

Regarding the addition of compost rates, the results reveal that the Ex. Ca, Mg, K and CEC values were significantly increased with increasing compost rates. The highest mean values were recorded by the addition of 7.5 ton compost fed^{-1}, where they reached to 21.54, 15.12, 0.91 and 43.26 meq/100g soil in the first season, and reached to 21.57, 15.15, 0.92 and 43.30 meq/100g in the second one. Similar results were obtained by **El-hady & Abo-Sedera (2006), El-Maddah et al (2012) and Agegnehu et al (2016)**.

2- Exchangeable sodium and exchangeable sodium percentage

The results in **Table (4)** indicate that the Ex. Na (meq/100 g soil) and the exchangeable sodium percentage (ESP, %) were significantly decreased with all treatments at the two soil depths (10 and 30 cm) in the two seasons. The lowest values of Ex. Na and ESP were caused by the addition of 7.5 ton compost fed^{-1} filled 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, where they decreased to 5.62 and 5.60 meq/100 g soil for Ex. Na and 12.96 and 12.90 % for ESP, in the first and second seasons, respectively. Similar results were obtained by **El-Shouny (2006**).

The results in the same table reveal that the Ex. Na and ESP values were significantly decreased by increasing the application depth, where the use of 30 cm mole depth was more effective than surface application on decreasing Ex. Na and ESP values. The decreases mean values of Ex. Na were reached to 5.74 and 5.72 meq/100 g soil, also the decreases of ESP were reach to 13.33 and 13.27% in the first and second seasons, respectively.

Regarding the application of nitrogen fertilizer rates, it can be noticed that the Ex. Na and ESP values were significantly decreased with increasing nitrogen fertilizer rates, where the lowest values were recorded by using 100 % recommended dose of nitrogen fertilizer for each crop. The lowest mean values of Ex. Na and ESP were decreased to 5.69 meq/100 g soil, 13.18 % in the first season, and to be 5.68 meq/100 g soil, 13.14 % in the second one, respectively.

Table 4. Effect of different treatments on exchangeable cations after maize and barley in the first and second seasons (summer 2017 and winter 2017/2018)

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed^{-1})	Maize (first season, summer 2017)						Barley (second season, winter 2017/2018)					
			Exchangeable cations, meq/100g soil				CEC, meq/100g soil	ESP, %	Exchangeable cations, meq/100g soil				CEC, meq/100g soil	ESP, %
			Ca	Mg	Na	K			Ca	Mg	Na	K		
D1	N1	C1	21.22	14.82	5.94	0.64	42.62	13.94	21.23	14.83	5.93	0.65	42.64	13.91
		C2	21.24	14.84	5.90	0.71	42.69	13.82	21.27	14.87	5.89	0.72	42.75	13.78
		C3	21.29	14.90	5.88	0.82	42.89	13.71	21.31	14.92	5.86	0.84	42.93	13.65
		C4	21.35	15.04	5.84	0.88	43.11	13.55	21.38	15.07	5.83	0.89	43.17	13.50
	N2	C1	21.24	14.85	5.90	0.66	42.65	13.83	21.26	14.86	5.88	0.67	42.67	13.78
		C2	21.32	14.96	5.81	0.73	42.82	13.57	21.35	14.99	5.80	0.74	42.88	13.53
		C3	21.35	15.00	5.79	0.80	42.94	13.48	21.37	15.02	5.77	0.81	42.97	13.43
		C4	21.45	15.11	5.76	0.90	43.22	13.33	21.48	15.14	5.75	0.91	43.28	13.29
	N3	C1	21.33	14.94	5.86	0.66	42.79	13.69	21.36	14.98	5.85	0.68	42.87	13.65
		C2	21.38	15.09	5.81	0.78	43.06	13.49	21.40	15.12	5.79	0.79	43.10	13.43
		C3	21.42	15.12	5.77	0.86	43.17	13.37	21.44	15.15	5.75	0.87	43.21	13.31
		C4	21.46	15.13	5.71	0.91	43.21	13.21	21.48	15.16	5.69	0.92	43.25	13.16
	N4	C1	21.37	14.97	5.82	0.70	42.86	13.58	21.40	15.01	5.82	0.72	42.95	13.55
		C2	21.44	15.03	5.74	0.81	43.02	13.34	21.48	15.08	5.74	0.83	43.13	13.31
		C3	21.54	15.11	5.62	0.89	43.16	13.02	21.58	15.16	5.62	0.91	43.27	12.99
		C4	21.60	15.14	5.57	0.97	43.28	12.87	21.63	15.18	5.56	0.98	43.35	12.83
D2	N1	C1	21.24	14.84	5.93	0.71	42.72	13.88	21.26	14.86	5.92	0.72	42.76	13.84
		C2	21.29	14.89	5.88	0.73	42.79	13.74	21.31	14.91	5.86	0.75	42.83	13.68
		C3	21.48	14.98	5.72	0.79	42.97	13.31	21.50	15.00	5.70	0.81	43.01	13.25
		C4	21.64	15.09	5.69	0.84	43.26	13.15	21.66	15.11	5.67	0.86	43.30	13.09
	N2	C1	21.29	14.90	5.87	0.72	42.78	13.72	21.31	14.92	5.85	0.74	42.82	13.66
		C2	21.38	14.95	5.80	0.76	42.89	13.52	21.40	14.97	5.78	0.78	42.93	13.46
		C3	21.39	14.98	5.76	0.85	42.98	13.40	21.41	15.00	5.74	0.87	43.02	13.34
		C4	21.56	15.10	5.70	0.94	43.30	13.16	21.58	15.12	5.68	0.96	43.34	13.11
	N3	C1	21.38	14.99	5.78	0.74	42.89	13.48	21.40	15.02	5.76	0.75	42.93	13.42
		C2	21.55	15.07	5.71	0.81	43.14	13.24	21.57	15.10	5.69	0.82	43.18	13.18
		C3	21.58	15.09	5.67	0.88	43.22	13.12	21.60	15.12	5.65	0.89	43.26	13.06
		C4	21.62	15.13	5.61	0.92	43.28	12.96	21.64	15.16	5.59	0.93	43.32	12.90
	N4	C1	21.54	15.02	5.75	0.78	43.09	13.34	21.56	15.05	5.73	0.79	43.13	13.29
		C2	21.57	15.06	5.72	0.80	43.15	13.26	21.59	15.09	5.70	0.81	43.19	13.20
		C3	21.61	15.18	5.66	0.85	43.30	13.07	21.63	15.21	5.64	0.86	43.34	13.01
		C4	21.66	15.21	5.62	0.89	43.38	12.96	21.68	15.24	5.60	0.90	43.42	12.90
A Application depth cm	D1 (surface)		21.38	15.00	5.80	0.80	42.97	13.49	21.40	15.03	5.78	0.81	43.03	13.44
	D2 (30 cm)		21.49	15.03	5.74	0.81	43.07	13.33	21.51	15.06	5.72	0.83	43.11	13.27
	F - test		**	**	**	**	**	**	**	**	**	**	**	**
B Nitrogen fertilizer	N1 (0%)		21.34	14.93	5.85	0.77	42.88	13.64	21.37	14.95	5.83	0.78	42.92	13.59
	N2 (50%)		21.37	14.98	5.80	0.80	42.95	13.50	21.40	15.00	5.78	0.81	42.99	13.45
	N3 (75%)		21.47	15.07	5.74	0.82	43.10	13.32	21.49	15.10	5.72	0.83	43.14	13.26
	N4 (100%)		21.54	15.09	5.69	0.84	43.16	13.18	21.57	15.13	5.68	0.85	43.22	13.14
	F - test		**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1 (0)		21.33	14.92	5.86	0.70	42.80	13.68	21.35	14.94	5.84	0.72	42.85	13.64
	C2 (2.5)		21.40	14.99	5.80	0.77	42.95	13.50	21.42	15.02	5.78	0.78	43.00	13.45
	C3 (5)		21.46	15.05	5.73	0.84	43.08	13.31	21.48	15.07	5.72	0.86	43.13	13.26
	C4 (7.5)		21.54	15.12	5.69	0.91	43.26	13.15	21.57	15.15	5.67	0.92	43.30	13.10
	F - test		**	**	**	**	**	**	**	**	**	**	**	**

Also, the results reveal that the Ex. Na and ESP values were significantly decreased with increasing compost rates, where the lowest values were obtained by the addition of 7.5 ton compost fed^{-1}. The decreases of Ex. Na were reached to 5.69 and 5.67 meq/100 g soil, and the decreases of ESP were reached to 13.15 and 13.10 % as a mean values in the first and second seasons, respectively. Similar conclusion was obtained by **El-Maddah et al (2012).**

III- Effect of different treatments on soil macronutrients and C/N ratio.

1- Soil macronutrients

Results in **Table (5)** indicate that total macronutrients of soil (N, P and K) were increased with all treatments for the two soil depths (10 and 30 cm) at the end of the two growing seasons. The highest values of total soil N, P and K were recorded by the addition of 7.5 ton compost fed^{-1} filled in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, where the increases were reached to 0.156, 0.053 and 0.349 % in the first season and 0.158, 0.056 and 0.360 % in the second one for the total soil N, P and K , respectively.

Data in **Table (5)** indicate that total soil N, P and K were significantly increased by increasing application depth, where the use of 30 cm mole depth was more effective on increasing total soil N, P and K than 10 cm surface depth. The increases of them reached to 0.148, 0.042 and 0.335 % in the first season, while in the second one reached to 0.150, 0.045 and 0.345 %, respectively as a mean values.

Concerning the application of nitrogen fertilizer rates, the results reveal that total soil N, P and K were significantly increased by using 100 % recommended dose of nitrogen fertilizer for each crop. It can be noticed that, the increases of total soil N, P and K reached to 0.151, 0.046 and 0.339 % in the first season, while in the second one reached to 0.152, 0.048 and 0.348 %, respectively. Similar conclusions were obtained by **Zhong et al (2014)**.

Concerning the application of compost rates, It can be noticed that increasing compost rates addition led to significant increases in total soil N, P and K. The highest values were obtained by the application of 7.5 ton compost fed^{-1}, where they increase to 0.151, 0.047 and 0.341 % in the first season, and 0.153, 0.050 and 0.354 % in the second one, respectively as a mean values. These results suggest that it may be practical to apply these compost rates to soils to increase NPK concentrations in the soil and thereby enhance its availability to plants. These results are in agreement with those reported by **El-Maddah et al (2012) and Gayathri & Srinivasamurthy (2016).**

2- Organic carbon (O.C) and C/N ratio

Data in **Table (5)** show that the soil organic carbon (O.C) and C/N ratio were significantly increased with all different treatments at the end of the two seasons. The highest values of (O.C) and C/N ratio were obtained by using 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, where they increased to 1.682 % and 10.78 in the first season, and 1.654 % and 10.47 in the second one, respectively. This may be due to the increase in total N is higher than that in O.C., narrower C/N ratio of the treated soils were obtained indicating the mineralization of organic nitrogen compounds and hence the possibility to save and provide available forms of N to growing plants. Similar conclusions were obtained by **Saraiya et al (2005)**, **El-hady & Abo-Sedera (2006) and Meena et al (2015)**.

The results clearly show that, increasing the application depth led to significantly increases in (O.C) and C/N ratio. It can be noticed that the use of 30 cm mole depth was more effective than 10 cm surface depth on increasing (O.C) and C/N ratio of the soil, where the increases were reached to 1.583 % and 10.71 in the first season, and 1.556 % and 10.40 in the second one, respectively as a mean values. Similar results were obtained by **El-Sodany et al (2016)**

Concerning the addition of nitrogen fertilizer rates, the results show that the values of (O.C) and C/N ratio of the soil were significantly increased by increasing nitrogen fertilizer rates, where the highest values were recorded by using 100 % recommended dose of nitrogen fertilizer for each crop. The increases of (O.C) and C/N ratio of the soil were reached to 1.615 % and 10.72 in the first season, while in the second one reached to 1.584 % and 10.41, respectively as a mean values. Similar results were recorded by **Wapa & Oyetola (2014) and Abd-Allah (2014).**

Also, the application of compost rates led to significantly increases of O.C and C/N ratio at the end of the two seasons. The highest values of O.C and C/N ratio were recorded by the application of 7.5 ton compost fed^{-1}, where its increases were 1.618 % and 10.73 in the first season, and 1.592 % and 10.42 in the second one, respectively as a mean values. Similar results were recorded by **Guo et al (2016) and Agegnehu et al (2016).**

Table 5. Effect of different treatments on soil macronutrients and C/N ratio after maize and barley in the first and second seasons (summer 2017 and winter 2017/2018)

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed-1)	Maize (first season, summer 2017)					Barley (second season, winter 2017/2018).				
			Total macronutrients, %			Organic carbon, %	C / N ratio	Total macronutrients, %			Organic carbon, %	C / N ratio
			N	P	K			N	P	K		
D1	N1	C1	0.138	0.032	0.319	1.467	10.63	0.142	0.035	0.328	1.465	10.32
		C2	0.140	0.034	0.323	1.491	10.65	0.144	0.038	0.335	1.489	10.34
		C3	0.142	0.035	0.329	1.514	10.66	0.145	0.040	0.339	1.501	10.35
		C4	0.145	0.037	0.334	1.549	10.68	0.147	0.041	0.347	1.524	10.37
	N2	C1	0.141	0.034	0.324	1.500	10.64	0.143	0.037	0.332	1.477	10.33
		C2	0.145	0.038	0.328	1.547	10.67	0.146	0.040	0.339	1.513	10.36
		C3	0.146	0.041	0.332	1.561	10.69	0.149	0.043	0.343	1.547	10.38
		C4	0.148	0.047	0.335	1.585	10.71	0.150	0.049	0.351	1.559	10.39
	N3	C1	0.143	0.037	0.327	1.523	10.65	0.144	0.039	0.334	1.489	10.34
		C2	0.147	0.040	0.332	1.571	10.69	0.149	0.042	0.341	1.545	10.37
		C3	0.149	0.044	0.336	1.594	10.70	0.151	0.047	0.348	1.569	10.39
		C4	0.152	0.050	0.341	1.629	10.72	0.154	0.052	0.354	1.605	10.42
	N4	C1	0.145	0.039	0.329	1.546	10.66	0.146	0.041	0.335	1.511	10.35
		C2	0.148	0.042	0.334	1.584	10.70	0.149	0.044	0.344	1.547	10.38
		C3	0.151	0.045	0.338	1.617	10.71	0.153	0.047	0.350	1.593	10.41
		C4	0.155	0.051	0.346	1.663	10.73	0.157	0.053	0.358	1.639	10.44
D2	N1	C1	0.139	0.033	0.321	1.479	10.64	0.143	0.036	0.331	1.477	10.33
		C2	0.142	0.036	0.325	1.515	10.67	0.145	0.039	0.338	1.501	10.35
		C3	0.144	0.037	0.331	1.538	10.68	0.146	0.041	0.342	1.514	10.37
		C4	0.145	0.038	0.336	1.552	10.70	0.148	0.042	0.349	1.536	10.38
	N2	C1	0.142	0.036	0.326	1.514	10.66	0.145	0.038	0.335	1.501	10.35
		C2	0.146	0.039	0.331	1.561	10.69	0.148	0.041	0.342	1.536	10.38
		C3	0.149	0.042	0.337	1.594	10.70	0.151	0.045	0.347	1.570	10.40
		C4	0.151	0.049	0.342	1.619	10.72	0.152	0.052	0.355	1.585	10.43
	N3	C1	0.145	0.039	0.329	1.549	10.68	0.146	0.040	0.337	1.514	10.37
		C2	0.148	0.041	0.335	1.585	10.71	0.149	0.044	0.343	1.550	10.40
		C3	0.153	0.045	0.340	1.642	10.73	0.154	0.049	0.349	1.606	10.43
		C4	0.155	0.052	0.344	1.668	10.76	0.156	0.056	0.357	1.630	10.45
	N4	C1	0.147	0.042	0.331	1.573	10.70	0.148	0.043	0.339	1.536	10.38
		C2	0.150	0.045	0.339	1.608	10.72	0.151	0.047	0.347	1.573	10.42
		C3	0.153	0.049	0.343	1.645	10.75	0.155	0.051	0.352	1.620	10.45
		C4	0.156	0.053	0.349	1.682	10.78	0.158	0.056	0.360	1.654	10.47
A Application depth cm	D1 (surface)		0.146	0.040	0.332	1.559	10.68	0.148	0.043	0.342	1.536	10.37
	D2 (30 cm)		0.148	0.042	0.335	1.583	10.71	0.150	0.045	0.345	1.556	10.40
	F - test		**	**	**	**	**	**	**	**	**	**
B Nitrogen fertilizer	N1 (0%)		0.142	0.035	0.327	1.513	10.66	0.145	0.039	0.339	1.501	10.35
	N2 (50%)		0.146	0.041	0.332	1.560	10.69	0.148	0.043	0.343	1.536	10.38
	N3 (75%)		0.149	0.044	0.336	1.595	10.71	0.150	0.046	0.345	1.564	10.40
	N4 (100%)		0.151	0.046	0.339	1.615	10.72	0.152	0.048	0.348	1.584	10.41
	F - test		**	**	**	**	*	**	**	**	**	**
C. Compost rates (ton)	C1 (0)		0.143	0.037	0.326	1.519	10.66	0.145	0.039	0.334	1.496	10.35
	C2 (2.5)		0.146	0.039	0.331	1.558	10.69	0.148	0.042	0.341	1.532	10.38
	C3 (5)		0.148	0.042	0.336	1.588	10.70	0.151	0.045	0.346	1.565	10.40
	C4 (7.5)		0.151	0.047	0.341	1.618	10.73	0.153	0.050	0.354	1.592	10.42
	F - test		**	**	**	**	**	**	**	**	**	**

IV- Economical analysis

Table (6) show the inputs production items of the experiments through the two growing seasons under study (summer season 2017 and winter season 2017/2018). The obtained results in **Fig. (1)** indicated that the highest net income value (16809.80 L.E fed^{-1}) was incorporated with the application of 5.0 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, which was the best treatment and should be recommended due to relative high net income comparing to the other treatments. This may be due to this treatment was recorded the highest values of yield in the first and second seasons, consequently high net profit. It can be seen that it is better from the economic view to increase the mole depth up to 30 cm to increase the net profit. These results are in line with those reported by **Amer (2016)**.

Finally, it could be concluded that under clay loam soil conditions, the use of compost at the rate 5 ton fed^{-1} filled moles at 30 cm depth with nitrogen fertilizer at the rate 100 % of the recommended dose have pronounced effect on improving most of the soil chemical properties.

Table 6. Input production items and output of the experiments through the two growing seasons under study (summer season 2017 and winter season 2017/2018)

Items	**Treatment**		**Unit**	**Unit price (LE)**
Input				
Mineral fertilizer				
Nitrogen fertilizer	0,50,75,100% from recommended dose		Kg N	5.67
Phosphorus fertilizer	Recommended dose		Kg P_2O_5	7.74
Potassium fertilizer			Kg K_2O	13.13
Compost			Ton	180
Land preparation				
Surface tillage 10 cm			per fed	150
30 cm mole depth			per fed	180
Seeds of maize	10	kg fed-1	Kg	17
Seeds of barley	50	kg fed-1	Kg	4.66
labor			per fed	550
pesticides			per fed	500
Other costs			per fed	200
Output				
Maize grain			Ton	2000
Barley grain			Ton	4000
Barley straw			Ton	1000

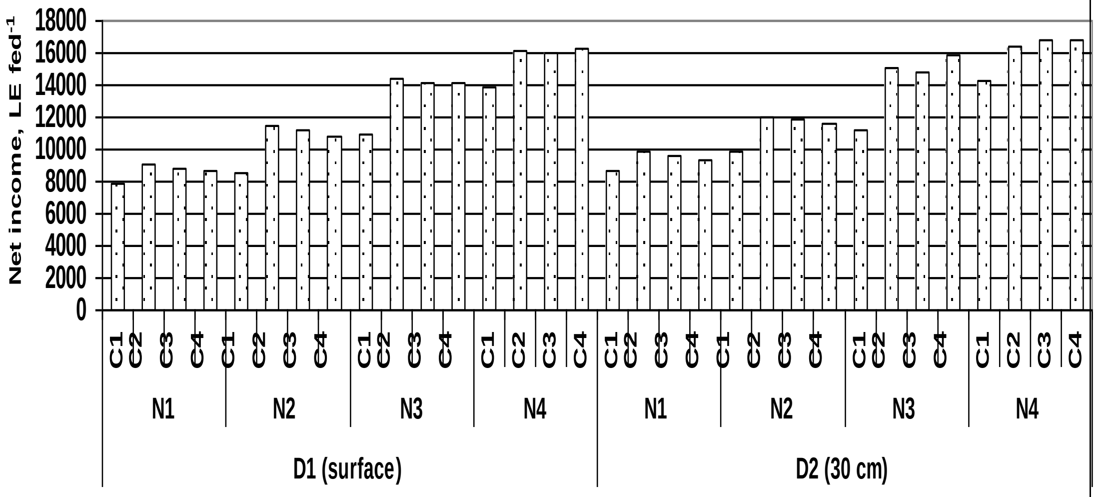

Fig. (1): Effect of different treatments on net income through the two growing seasons

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تأثير التسميد النتروجيني مع إضافة معدلات من الكمبوست في أعماق مختلفة علي بعض الخصائص الكيميائية للتربة

[161]

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الموجـــــــز

نفذت تجربتين حقليتين علي ارض طميية طينية خلال موسمين زراعيين، موسم صيفي 2017 باستخدام نبات الذرة الشامية وموسم شتوي 2018/2017 باستخدام نبات الشعير، في محطة البحوث الزراعية بالجميزة، محافظة الغربية وذلك لتقييم التأثيرات المباشرة والمتبقية لإضافة معدلات من الكمبوست علي سطح التربة، وفي أنفاق متوازية علي عمق 30 سم والمسافة بين هذه الأنفاق 3 متر بجانب تأثير معدلات من التسميد النتروجيني علي تحسين بعض الخصائص الكيميائية للتربة بالإضافة إلي إجراء التقييم الاقتصادي المحسوب علي أساس صافي الدخل لكل معاملة لتحديد المعاملة الاقتصادية. وكانت معدلات الكمبوست المضافة هي صفر ، 2,5 ، 5,0، 7,5 طن/ف، بينما معدلات إضافة النتروجين هي صفر ، 50 ، 75 ، 100 % من الكمية الموصي بها لكل محصول. وكان تصميم التجربة قطاعات كاملة العشوائية منشقة مرتين في ثلاث مكررات.

أدت كل المعاملات إلي انخفاض رقم حموضة التربة خلال موسمي النمو. حدثت زيادة معنوية في قيم ملوحة التربة والأملاح الكلية الذائبة وقيم الكاتيونات والانيونات الذائبة بزيادة معدلات النتروجين والكمبوست ونقص معنوي بزيادة عمق الإضافة. وعلي الجانب الأخر، حدث نقص معنوي في قيم نسبة الصوديوم المتبادل مع كل المعاملات. أدت كل المعاملات إلي زيادة معنوية في الكالسيوم والماغنسيوم والبوتاسيوم المتبادل والسعة التبادلية الكاتيونية، بينما حدث انخفاض معنوي في الصوديوم المتبادل والنسبة المئوية للصوديوم المتبادل مع كل المعاملات خلال موسمي النمو. أدت كل المعاملات إلي زيادة معنوية في المغذيات الكبرى (النتروجين، والفوسفور والبوتاسيوم) ، كما زادت قيم الكربون العضوي ونسبة الكربون إلي النتروجين معنويا في كل المعاملات. يؤكد التحليل الاقتصادي أن إضافة 5,0 طن كمبوست/ف في أنفاق علي عمق 30 سم مع معدل 100 % من الموصي به من التسميد النتروجيني لكل محصول كانت أفضل معاملة بالمقارنة مع باقي المعاملات حيث أعطت تحسنا واضحا في الخصائص الكيميائية للتربة والذي انعكس علي زيادة المحصول وإعطاء اعلي صافي دخل مزرعي (16809.80 جنية / فدان).

الكلمات الدالة: انفاق ، كمبوست، الخواص الكيميائية للتربة

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