Minia J. of Agric. Res. & Develop.
Vol. (39), No. 1, pp. 101-132, 2019

FACULTY OF AGRICULTURE

EFFECT OF NITROGEN FERTILIZER AND COMPOST RATES ADDITION AT DIFFERENT DEPTHS ON THE STATUS OF SOME MACRO AND MICRONUTRIENTS IN SOIL AND PLANTS AND THE PRODUCTIVITY OF MAIZE AND BARLEY PLANTS

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Received: 1April (2019) Accepted: 4 July (2019)

ABSTRACT

Field experiments were conducted on clay loam soil during the two successive seasons, summer season 2017 using maize plants (*Zea mays L*.) and winter season (2017/2018) using barley plants (*Hordum vulgare L*.) at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate to evaluate the direct and residual effects of compost rates placed in 30 cm moles depth, arranged in parallel orientation with respect to one another and spaced at 3 m apart or placed on the surface soil layers besides the nitrogen fertilizer rates on availability of some soil macro and micronutrients and chemical composition of maize and barley plants, also the productivity of yield and yield components.

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 split-split plot in a randomized complete block design (RCBD) with three replicates.

All different treatments led to markedly increases in available NPK in the two growing seasons. Soil extractable metals (Fe, Zn, Mn and Cu) were increased with all treatments in the two growing seasons. Concentration and uptake of macronutrients (N, P, and K) and micronutrients (Fe, Zn, Mn and Cu) in maize and barley grains and straw were increased with all different treatments in the two seasons. The yield and yield components of maize and barley positively responded to all treatments. Generally, it could be concluded that, the highest values of yield and its components for maize and barley plants were obtained by the addition of 7.5-ton compost fed^{-1} in 30 cm mole depth with 100% of the recommended dose for nitrogen fertilizer and get a markedly improvement in availability of macro and micronutrients to the plants. The highest grain yield of maize plants increased to 3.3787 ton fed^{-1}, also the highest grain and straw yields of barley plants increased to 2.9327 and 4.2013 ton fed^{-1}, respectively. Accumulation of micronutrients in plant biomass was within the normal range and did not produce depressing effects on crop yields.

Key words: Moles, compost, macro and micronutrients.

INTRODUCTION

El-Sodany *et al.* (2016) found that the application depths at (0-20 and 20-40cm) and the addition rates of compost clearly enhanced the nutrient statues of the investigated soil, where the available macronutrients (N, P and K) and micronutrients (Fe, Zn, Mn and Cu) of the soil at the two soil depths in the two growing seasons were increased. Also, the yield and yield components of maize and wheat positively responded to all treatments compared with the control. The highest values of yield and its components for maize and wheat plants were obtained by the addition of 10 ton compost fed^{-1} in 40 cm mole depth.

Eghball *et al*. (2004) found that the residual effects of manure and compost applications significantly increased plant-available P and NO3–N concentrations. Saraiya *et al*. (2005) showed that the application of compost prepared from rice residue to wheat increased available nitrogen and grain and straw yield of wheat.

Amer (2016) referred that soil nutrients availability and NPK uptake by crops were 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.

Meena *et al*. (2015) indicated the higher value of available nitrogen (N), phosphorus (P), potassium (K) were observed in farmyard manure applied equivalent to 120 kg N/ha followed by vermicompost equivalent to 120 kg N/ha. Grain yield of maize was significantly higher in the treatments of recommended dose of fertilizers and vermicompost equivalent to 120 kg N/ha.

Walker *et al.* (2004) found that manure application greatly increased shoot growth and reduced the shoot concentrations of Cu, Zn, and Mn, and their plant-available concentrations in the soil. These effects appeared to be related to an increase of soil pH, due to an inhibition of sulphide oxidation/hydrolysis, relative to the non-amended soil. Abd-Allah (2014) reported that markedly increases in available soil N, P and K were happened by all added different natural amendments, i.e., water hyacinth compost, rice straw compost and farmyard manure compost and their combinations. Also, soil micronutrients (Fe, Mn, Zn and Cu) were increased with all added organic amendments in the two growing seasons. Concentration of N, P and K and micronutrients in maize grains and flax seeds were increased with all added natural amendments. El-Sodany *et al.* (2015) show that all natural soil amendments led to markedly increases in available NPK, soil extractable metals (Fe, Zn, Mn and Cu) and the concentration and uptake of NPK and Fe, Zn, Mn and Cu in maize and wheat grains and straw at the two soil depths in the two growing seasons.

Compost may be utilized in the soil as a source of macro and micronutrients for crop production (Parr and Hornick, 1990). Maiorana *et al.* (2005) concluded that the compost application allowed good yields and quality, even without an additional mineral fertilization.

Osman *et al.* (2014) found that increasing the addition of compost up to 4 t fed^{-1} increased significantly values of plant height, plant dry matter at 90 days from planting as well as the head diameter, seed yield/ plant, 1000 seed weight and seed yield (t fed-1) of sunflower plant at harvest time 120 days from planting. Also, they found significantly increases values of N, P and K of sunflower seeds compared to control treatment (without addition of compost) in both seasons. Sowicki (2003) stated that compost addition significantly increased sunflower dry weight, seed yield, oil content and major elements (NPK).

Darmody *et al.* (1983) noted that many metals were mobile in a silt loam receiving heavy sludge application, and Cu had greater downward movement than the other metals 3 yr after the initial application. Campbell and Beckett (1988) found that downward migration was observed 7 yr after sludge application where soluble Cu, Zn, and Cd were greater at the depth of 40 to 60 cm in the sludge-treated soil than in the untreated soil. McCarthy and Zachara (1989) found that dissolved organic matter can facilitate metal transport in soil and ground water by acting as a carrier through formation of soluble metal–organic complexes. Giusquiani *et al.* (1995) stated that in the amended plots total and humified organic C, Pb, Cu, and Zn showed a significant increase compared with non-amended plots.

Mostafa (2001) found that uptake and concentrations of macronutrients (N, P and K) and trace elements "Fe, Zn, Mn and Cu" were increased due to the addition of poultry manure combined with olive cake residues. El-Maddah (2005) found that soil extractable metals (Fe, Zn, Mn and Cu) were increased with all added organic amendments, also the concentration and uptake of macronutrients (N, P and K) and micronutrients (Fe, Zn, Mn and Cu) in wheat and maize grains were increased as a results of organic amendments addition.

Bharath *et al*. (2017) found that post-harvest available (N, P and K) content after kharif maize were significantly higher with interaction of organic manures (farmyard manure and urban, compost) with inorganic fertilizer. Chaoui *et al.* (2003) show that all compost amendments significantly increased wheat P and K uptake compared to either the non-amended control or the mineral fertilizer treatment.

Barabasz *et al.* (2002) found from the three elements N, P, K used for fertilization, nitrogen is one of the most important factors affecting soil fertility and productivity as well as the growth and development of cultivated plants.

For sustainable agriculture, it is important to know how nitrogen interacts with other nutrients in order to improve efficient utilization of this element and, consequently, to enhance yields. Positive interactions between N and other nutrients have been reported by Holford et al. (1992), Zhao et al. (1997) and Smolen and Sady (2009). They reported that positive interactions of N with P, K, Ca and other nutrients may be associated with improved yield when N is added.

Marschner (1995) found that nitrogen play important role in cation-anion balances since it’s the most nutrient absorbed by most of the plants. Irani-Sarand *et al.* (2013) represented that long term using of urea increases concentration of Zn, P, Fe and Mn of soil by decreasing pH.

Sinha (1972) suggested that the organic acids are produced during the decomposition of organic matter in soils influence the pH and consequently rendered available P from calcium phosphate. Derar and Eid (1996) reported that the concentrations of N, P and K in wheat and corn grains were increased upon increasing sludge application.

El-Fayoumy *et al.* (2000) reported that organic matter application may cause easily and gradual availability of micronutrients and heavy metals to the plants or may be cause accumulation of these elements and subsequently biologically increase their absorption by plants. They added also that most of micronutrients and heavy metals are usually precipitated due to basic soil reaction or absorbed on colloidal organic and inorganic constituents when they are added to the soil, these processes usually affect their availability to plants. El-Fayoumy *et al.* (2001) reported that application of organic amendments had a decrease in soil pH and clearly enhanced the nutrient status of soil and its uptake by plants.

The aim of this work is to fined out the direct and residual effects of compost rates placed in moles at 30 cm depth, arranged in parallel orientation with respect to one another's at 3 m spacing or placed on the surface soil layer with nitrogen fertilizer rates on improving the status of some macro and micronutrients in soil and plants, which reflect on the productivity of yield and yield components of maize and barley plants.

MATERIALS AND METHODS

To study the effect and residual effects of compost rates placed at 30 cm mole depth arranged in parallel orientation with respect to one another and spaced at 3 m aparts or placed on the surface soil layers besides the nitrogen fertilizer rates on status of some macro and micronutrients of soil and plants. Field experiments were carried out at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate, during two consecutive growing seasons. Summer season 2017 using maize plants (*Zea mays L.*) and winter season 2017 / 2018 using barley plants (*Hordum vulgare*). Some soil properties of the experimental soil are presented in Table (1-a) and the compost used analysis are shown in Table (1-b).

The factors involved in this study were two application depths D1 = Surface addition ≈ 10 cm depth and D2 = 30 cm mole depth, as the main plots, while nitrogen fertilizer applying from recommended dose for each crop with rates (N1 = 0.0 % (without), N2 = 50 %, N3 = 75 % and N4 = 100 %) was considered as sub plots and the compost with rates (C1 = 0.0 (without), C2 = 2.5, C3 = 5.0 and C4 = 7.5 ton fed^{-1}) was considered as sub-sub plots.

The experimental fields consisted of 32 plots with three replicates, using a split-split plot in randomized complete block design. The plot area of the experiment was 24 m^2, each plot was done in 6 m length and 4 m width.

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 hybrids 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 first 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.

At harvesting of each growing season, soil and plant samples were collected from each plot. The collected soil samples (10 and 30 cm depths) were air-dried, ground and passed through 2 mm sieve and stored for analysis. Also, maize and barley grains and straw samples were ground, wet digested as described by Chapman and Pratt (1961).

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							
EC, dSm^{-1}		1.80	2.00	Organic carbon (O.C, %)		1.467	1.304
pH, 1:2.5 (susp.)		7.80	8.06	Total nitrogen (T.N, %)		0.138	0.127
Organic matter (O.M, %)		2.53	2.25	C/N ratio		10.63	10.27
Soluble ions, meq l^{-1}	Ca^{2+}	5.28	4.93	Soil available macronutrients (ppm)	N	31.64	30.99
	Mg^{2+}	3.77	3.42		P	10.10	9.98
	Na^{+}	8.84	11.57		K	287.40	281.80
	K^{+}	0.11	0.08	Soil available micronutrients, ppm	Fe	3.40	3.33
	HCO^{3-}	2.65	2.81		Zn	3.19	3.12
	Cl^{-}	8.30	8.83		Mn	2.63	2.58
	SO_4^{2-}	7.05	8.36		Cu	1.27	1.21

Table (1-b): Some characteristics of the used compost.

Properties	Compost	Properties	Compost
pH (1:10 manure: water)	7.39	Bulk density, g/cm3	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, %	1.60
Cu, ppm	31.25		

Available NPK of soil were determined according to Hesse (1971). Available N (extracted by 2M KCl) determined using the micro-kjeldahel method. Available P (extracted by 0.5N $NaHCO_3$ solution at pH 8.3) determined using ascorbic acid method and available K (extracted by ammonium acetate solution at pH 7.0) was determined using the flame photometer.The concentrations of micronutrients (Fe, Mn, Zn and Cu) of soil samples were determined by DTPA-method as described by Lindsay and Norevell (1978) measured by an Atomic Absorption Spectrophotometer (AAS).

The concentration of macronutrients in grains and straw samples were determined according to Hesse (1971) and Cottenie (1980). Nitrogen was determined by Kjeldahel method, phosphorus by Vanadomolybdate yellow method according to Jakson (1973) and potassium by flame photometer method.

Total yield (maize and barley) for each plot was separately harvested, weighed and related to tons fed^{-1}. Also, 100 corn seed and 1000 barley seed weight, barley straw (Ton/fed.) were determined for each treatment. Ten random plants per plot were sampled at harvest of each crop to determine the following characters.

Maize growth characters:

1- Plant height, (cm)
2- Ear length, (cm)
3- Ear diameter, (cm)
4- Number of rows per ear.
5- Number of kernels per row 6- Dry matter after 80 days of sowing (g $plant^{-1}$)

Barley growth characters:

1- Plant height, (cm)
2- Spike length, (cm)
3- Number of kernels per spike
4- Number of spikes per m^2
5- Dry matter after 90 days of sowing, g $(10\ plants)^{-1}$

The obtained data were statistically analyzed according to procedure out lined by Sendecor and Cochran (1981).

RESULTS AND DISCUSSION

I- Effect of different treatments on the status of soil nutrients.

1- Soil available macronutrients.

Data in Table (2) indicate that all different treatments led to markedly increases in available soil nitrogen, phosphorus and potassium. The highest values of available soil N, P and K were recorded 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, where they increased to 42.17, 15.43 and 441.70 ppm in the first season, and were 41.30, 14.36 and 438.70 ppm in the second one, respectively. Similar results were reported by Bharath *et al*. (2017).

The results reveal that the available soil N, P and K values were significantly increased by using 30 cm mole depth, where it was more effective than the surface depth on increasing these values. The available soil N, P and K were ranged from 35.96 to 36.73, 12.20 to 12.61 and 351.74 to 362.66 ppm in the first season, and 35.34 to 36.05, 11.35 to 11.74 and 349.06 to 359.72 ppm in the second one, respectively. Similar results were reported by El-Sodany *et al.* (2016).

Regarding nitrogen fertilizers, the results show that the addition of N fertilizer rates caused significantly increases in the available soil N, P and K, where the highest values were recorded by using 100 % recommended dose of nitrogen fertilizer for each crop. The highest mean values of available soil N, P and K were increased to 39.81, 14.19 and 410.74 ppm in the first season, and 39.15, 13.23 and 407.34 ppm in the second one, respectively. Similar results were reported by Holford *et al.* (1992), Zhao *et al.* (1997) and Smolen and Sady (2009). Likewise, it can be noticed significant increases in available soil N, P and K were observed by increasing compost rates addition, where the highest values were recorded by the addition of 7.5 ton compost fed^{-1}. The highest values of available soil N, P and K were increased to 37.36, 12.91 and 372.14 ppm in the first season, and 36.67, 12.01 and 369.02 ppm in the second one, respectively. Similar results were reported by Saraiya *et al*. (2005), Abd-Allah (2014) and Meena *et al*. (2015**)**

2- Soil micronutrients.

Data presented in Table (2) indicate that the concentration of soil micronutrients (Fe, Zn, Mn and Cu) were markedly increased in all treatments in the first and second seasons. The highest values of soil micronutrients 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, where it increased to 5.49, 4.87, 4.99 and 2.26 ppm, and 5.38, 4.92, 5.02 and 2.30 ppm in the first and second seasons for Fe, Zn, Mn and Cu, respectively.

Concerning the application depth, the results indicated that the values of Fe, Zn, Mn and Cu concentrations of the soil were significantly increased by using 30 cm mole depth. The highest values of them concentrations were obtained by using 30 cm mole depth, where they increased to 4.53, 4.06, 3.82 and 1.78 ppm in the first season and increased to 4.45, 4.14, 3.90 and 1.83 ppm in the second one, respectively.

Table (2): Effect of different treatments on soil available macro and micronutrients 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).						
			Available macronutrients, ppm			Available micronutrients, ppm				Available macronutrients, ppm			Available micronutrients, ppm			
			N	P	K	Fe	Zn	Mn	Cu	N	P	K	Fe	Zn	Mn	Cu
D1	N1	C1	31.66	10.11	288.40	3.41	3.20	2.64	1.28	31.26	9.48	287.74	3.27	3.07	2.66	1.34
		C2	32.80	10.66	301.48	3.61	3.36	2.79	1.38	32.21	9.89	300.78	3.59	3.44	2.92	1.44
		C3	32.98	10.74	303.29	3.68	3.40	2.82	1.39	32.36	10.00	303.09	3.65	3.48	2.94	1.45
		C4	33.18	10.83	306.81	3.70	3.42	2.87	1.41	32.65	10.08	305.91	3.67	3.51	2.99	1.48
	N2	C1	32.58	10.52	297.92	3.56	3.33	2.77	1.36	32.01	9.82	297.98	3.51	3.38	2.85	1.42
		C2	35.50	11.97	345.38	4.34	3.87	3.52	1.68	34.82	11.12	341.00	4.33	3.97	3.60	1.73
		C3	35.70	12.06	348.06	4.38	3.94	3.56	1.69	34.99	11.19	344.28	4.37	4.02	3.65	1.75
		C4	35.92	12.14	350.75	4.42	3.97	3.61	1.71	35.21	11.28	347.30	4.40	4.06	3.71	1.76
	N3	C1	34.74	11.56	330.85	4.16	3.75	3.25	1.59	34.07	10.76	327.86	4.10	3.83	3.36	1.68
		C2	37.57	12.97	379.25	4.79	4.26	4.13	1.90	36.87	12.08	374.39	4.72	4.34	4.17	1.93
		C3	37.87	13.05	381.59	4.83	4.29	4.16	1.92	37.12	12.17	376.47	4.76	4.39	4.23	1.95
		C4	38.26	13.23	387.39	4.93	4.35	4.31	1.94	37.46	12.33	382.60	4.79	4.44	4.36	1.97
	N4	C1	36.92	12.69	370.24	4.64	4.16	3.96	1.83	36.28	11.84	363.95	4.60	4.23	4.02	1.86
		C2	39.61	14.03	406.53	5.26	4.60	4.68	2.10	39.07	13.00	405.94	5.09	4.67	4.72	2.13
		C3	39.83	14.15	410.67	5.29	4.63	4.72	2.12	39.36	13.15	409.71	5.12	4.72	4.76	2.16
		C4	40.28	14.45	419.19	5.31	4.67	4.76	2.15	39.72	13.48	415.94	5.17	4.76	4.80	2.19
D2	N1	C1	32.02	10.25	290.45	3.44	3.22	2.66	1.31	31.46	9.55	289.98	3.36	3.29	2.75	1.37
		C2	33.52	10.98	310.27	3.79	3.50	2.98	1.45	32.96	10.25	311.42	3.78	3.56	3.08	1.53
		C3	33.70	11.07	312.07	3.87	3.53	3.01	1.46	33.12	10.31	312.12	3.84	3.60	3.11	1.56
		C4	33.96	11.15	316.79	3.90	3.56	3.05	1.50	33.27	10.37	314.15	3.87	3.64	3.15	1.58
	N2	C1	33.34	10.89	307.88	3.75	3.46	2.94	1.44	32.80	10.16	306.60	3.73	3.54	3.05	1.50

		C2	36.02	12.24	352.74	4.44	3.99	3.65	1.73	35.30	11.36	349.09	4.42	4.08	3.74	1.77
		C3	36.23	12.33	357.00	4.49	4.02	3.71	1.75	35.53	11.45	352.36	4.45	4.11	3.80	1.78
		C4	36.36	12.40	358.93	4.53	4.05	3.75	1.77	35.62	11.52	354.39	4.49	4.13	3.84	1.80
	N3	C1	35.16	11.78	338.80	4.24	3.79	3.38	1.63	34.46	10.94	334.57	4.22	3.89	3.48	1.69
		C2	38.33	13.31	389.98	4.98	4.38	4.37	1.96	37.60	12.37	385.26	4.82	4.47	4.45	1.98
		C3	38.49	13.50	392.84	5.03	4.42	4.42	1.98	37.83	12.54	389.31	4.86	4.50	4.48	2.00
		C4	38.74	13.62	395.57	5.10	4.46	4.49	2.01	38.13	12.63	393.18	4.92	4.54	4.54	2.02
	N4	C1	37.14	12.80	374.20	4.69	4.19	4.03	1.86	36.50	11.93	368.42	4.63	4.25	4.07	1.89
		C2	40.99	14.90	429.67	5.36	4.73	4.84	2.19	40.30	13.98	424.37	5.23	4.82	4.88	2.22
		C3	41.51	15.08	433.71	5.42	4.81	4.91	2.22	40.68	14.11	431.66	5.26	4.89	4.95	2.25
		C4	42.17	15.43	441.70	5.49	4.87	4.99	2.26	41.30	14.36	438.70	5.38	4.92	5.02	2.30
A	D1 (surface)		35.96	12.20	351.74	4.39	3.95	3.66	1.72	35.34	11.35	349.06	4.32	4.02	3.73	1.77
Application depth	D2 (30 cm)		36.73	12.61	362.66	4.53	4.06	3.82	1.78	36.05	11.74	359.72	4.45	4.14	3.90	1.83
cm	F - test		**	**	**	**	**	*	*	**	**	**	**	**	*	*
B	N1 (0%)		32.98	10.72	303.70	3.68	3.40	2.85	1.40	32.41	9.99	303.15	3.63	3.45	2.95	1.47
Nitrogen	N2 (50%)		35.21	11.82	339.83	4.24	3.83	3.44	1.64	34.54	10.99	336.63	4.21	3.91	3.53	1.69
fertilizer	N3 (75%)		37.40	12.88	374.53	4.76	4.21	4.06	1.87	36.69	11.98	370.46	4.65	4.30	4.13	1.90
	N4 (100%)		39.81	14.19	410.74	5.18	4.58	4.61	2.09	39.15	13.23	407.34	5.06	4.66	4.65	2.13
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**
C	C1 (0)		34.20	11.33	324.84	3.99	3.64	3.20	1.54	33.61	10.56	322.14	3.93	3.69	3.28	1.59
Compost	C2 (2.5)		36.79	12.63	364.41	4.57	4.09	3.87	1.80	36.14	11.76	361.53	4.50	4.17	3.95	1.84
rates	C3 (5)		37.04	12.75	367.40	4.62	4.13	3.91	1.82	36.37	11.87	364.88	4.54	4.21	3.99	1.86
(ton)	C4 (7.5)		37.36	12.91	372.14	4.67	4.17	3.98	1.84	36.67	12.01	369.02	4.59	4.25	4.05	1.89
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**

It can be noticed that the use of 30 cm mole depth was more effective than surface depth on increasing the values of Fe, Zn, Mn and Cu concentrations in soil. Similar results were reported by El-Sodany *et al.* (2016)

With regard to nitrogen fertilizer rates additions, the results clear that the values of Fe, Mn, Zn and Cu concentrations of the soil were significantly increased with increasing addition of nitrogen fertilizers rates, where the highest values were obtained by the addition of 100 % recommended dose of nitrogen fertilizer for each crop. These values were increased to 5.18 and 5.06 ppm for Fe, 4.58 and 4.66 ppm for Zn, 4.61 and 4.65 ppm for Mn and 2.09 and 2.13 ppm for Cu in the first and second seasons, respectively. Similar results were reported by Irani-Sarand *et al.* (2013).

Also, the results clear that the values of Fe, Mn, Zn and Cu concentrations of the soil were significantly increased with increasing the addition compost rates, where the highest values were obtained with the addition of 7.5 ton compost fed^{-1}. These values were increased to 4.67 and 4.59 ppm, 4.17 and 4.25 ppm, 3.98 and 4.05 ppm and 1.84 and 1.89 ppm in the first and second seasons, respectively. Similar results were reported by Abd-Allah (2014), who found that soil micronutrients (Fe, Mn, Zn and Cu) were increased with all added organic amendments in the two growing seasons. These increases may be mainly due to the effect of these amendments on lowering soil pH which reflects on increasing the availability of these micronutrients. Also, these results agree with those of El-Fayoumy *et al.* (2001) where they reported that application of organic amendments had a decrease in soil pH and clearly enhanced the nutrient status of soil and its uptake by plants.

II- Effect of different treatments on the status of plant nutrients.

1- Macronutrient concentrations and its uptake by maize and barley grains.

Data in Tables (3 and 4) show that the macronutrients concentration and its uptake by maize and barley grains were significantly increased by increasing all treatments in the first and second seasons.

The results show that N, P and K concentrations and its uptake by maize and barley grains were increased with all treatments in the two seasons. The highest values were recorded with the addition of 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop, where these values were 2.137 and 1.996 %, 67.90 and 52.79 kg fed^{-1} for N concentration and uptake, 0.647 and 0.585 % , 20.82 and 15.54 kg fed^{-1} for P concentration and uptake and 0.677 and 0.651 %, 26.75 and 19.41 kg fed^{-1} for K concentration and uptake, by maize and barley grains in the first and second seasons, respectively.

Table (3): Effect of different treatments on macronutrients concentration (%), uptake (Kg fed[-1]) and DTPA- extractable metals of maize grains in the first season (summer 2017).

Application depth cm	Nitrogen fertilizer	Compost Rates (ton fed⁻¹)	Macronutrients Concentration, % N	P	K	Uptake, Kg fed⁻¹ N	P	K	DTPA- extractable micronutrients (mg Kg⁻¹) Fe	Zn	Mn	Cu	Micronutrients Uptake, g fed⁻¹ Fe	Zn	Mn	Cu
D1	N1	C1	1.427	0.368	0.456	34.12	9.13	11.46	115.72	72.03	43.50	11.55	26.49	15.89	9.70	2.36
		C2	1.454	0.391	0.478	35.42	9.75	12.60	122.43	73.90	44.63	11.79	30.02	16.92	10.67	2.78
		C3	1.458	0.396	0.482	35.86	9.93	12.81	123.08	74.24	44.83	11.85	30.54	17.24	10.99	2.83
		C4	1.463	0.399	0.486	36.40	10.10	13.05	124.02	74.61	45.30	12.07	30.87	17.36	11.98	2.88
	N2	C1	1.446	0.386	0.472	35.04	9.54	12.33	121.26	73.33	43.77	11.67	29.51	16.40	10.19	2.71
		C2	1.549	0.446	0.534	43.84	13.03	16.37	133.88	76.11	61.47	12.00	37.57	22.88	14.61	3.43
		C3	1.554	0.449	0.537	44.50	13.29	16.45	134.31	78.40	61.63	12.04	37.68	23.24	15.08	3.48
		C4	1.561	0.453	0.540	45.52	13.68	16.78	135.62	79.90	62.61	12.11	38.73	23.86	16.06	3.56
	N3	C1	1.524	0.436	0.521	42.03	12.38	15.49	131.43	77.93	59.54	11.79	35.73	21.84	13.28	3.27
		C2	1.627	0.485	0.578	52.26	16.10	19.60	142.51	80.70	67.96	12.84	44.26	26.64	17.38	4.25
		C3	1.631	0.488	0.585	52.57	16.38	19.70	143.13	81.96	68.13	12.94	44.90	28.14	17.64	4.28
		C4	1.639	0.491	0.590	53.25	16.55	20.31	144.05	82.53	69.06	13.00	45.59	29.01	18.15	4.35
	N4	C1	1.608	0.477	0.568	50.62	15.32	18.33	140.00	82.39	65.99	12.47	42.42	26.37	16.85	4.05
		C2	2.019	0.578	0.623	59.01	18.54	23.82	149.86	85.23	73.08	13.51	50.13	29.51	21.13	4.98
		C3	2.033	0.585	0.626	60.73	18.89	24.30	150.95	88.81	74.13	13.62	51.24	31.89	23.08	5.04
		C4	2.079	0.611	0.648	63.69	19.48	24.69	154.18	91.57	75.19	13.82	52.57	33.71	25.96	5.13
D2	N1	C1	1.435	0.374	0.463	34.43	9.23	11.99	117.71	72.39	44.19	11.75	27.76	16.13	10.18	2.48
		C2	1.483	0.409	0.495	37.27	10.52	13.46	125.91	74.59	46.30	12.21	31.91	17.86	12.54	2.96
		C3	1.489	0.413	0.499	37.92	10.75	13.81	126.61	75.88	46.60	12.28	32.48	18.11	14.82	3.00
		C4	1.500	0.417	0.503	38.75	11.04	13.98	127.77	76.26	56.70	13.02	33.07	19.34	15.17	3.03
	N2	C1	1.471	0.404	0.490	36.79	10.28	13.27	124.97	75.03	45.67	12.15	31.32	17.56	12.27	2.93
		C2	1.567	0.456	0.544	45.77	13.76	16.90	136.04	78.13	62.76	13.66	39.09	23.06	17.17	3.62

		C3	1.577	0.459	0.548	46.45	14.06	17.24	136.78	79.67	63.74	13.73	39.79	24.46	21.12	3.71
		C4	1.583	0.463	0.553	47.69	14.25	17.35	137.16	80.98	63.92	13.77	40.15	24.83	23.88	3.80
	N3	C1	1.533	0.439	0.526	42.94	12.67	15.87	132.28	78.38	60.45	13.14	36.77	22.33	17.17	3.32
		C2	1.648	0.495	0.594	53.96	16.68	20.95	144.61	82.81	69.23	14.34	46.21	27.58	20.34	4.48
		C3	1.653	0.501	0.596	55.03	17.20	21.47	145.52	84.15	70.20	14.40	47.01	29.24	23.48	4.58
		C4	1.660	0.506	0.602	55.53	17.45	22.03	146.21	85.65	70.48	14.46	47.64	30.53	25.30	4.67
	N4	C1	1.617	0.479	0.571	51.13	15.64	18.63	141.02	83.75	66.81	13.81	43.10	27.10	19.62	4.11
		C2	2.104	0.627	0.663	65.69	19.90	25.30	156.60	87.75	76.63	15.26	53.19	31.45	23.43	5.17
		C3	2.116	0.635	0.669	66.58	20.23	25.92	158.01	90.37	77.11	15.36	53.91	33.79	26.60	5.28
		C4	2.137	0.647	0.677	67.90	20.82	26.75	159.55	92.09	78.27	15.47	54.83	35.42	29.54	5.36
A Application depth cm	D1 (surface)		1.630	0.465	0.545	46.55	13.88	17.38	135.40	79.60	60.05	12.44	39.27	23.81	15.80	3.71
	D2 (30 cm)		1.661	0.483	0.562	48.99	14.66	18.43	138.55	81.12	62.44	13.68	41.14	24.92	19.54	3.91
	F - test		**	*	**	*	*	*	**	**	*	**	*	*	**	*
B Nitrogen fertilizer	N1 (0%)		1.464	0.396	0.483	36.27	10.06	12.90	122.91	74.24	46.51	12.07	30.39	17.36	12.01	2.79
	N2 (50%)		1.539	0.440	0.527	43.20	12.74	15.84	132.50	77.69	58.20	12.64	36.73	22.04	16.30	3.41
	N3 (75%)		1.614	0.480	0.574	50.95	15.68	19.43	141.22	81.76	66.88	13.36	43.51	26.91	19.09	4.15
	N4 (100%)		1.964	0.580	0.631	60.67	18.60	23.47	151.27	87.75	73.40	14.17	50.17	31.16	23.28	4.89
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1 (0)		1.508	0.420	0.508	40.89	11.77	14.67	128.05	76.90	53.74	12.29	34.14	20.45	13.66	3.15
	C2 (2.5)		1.681	0.486	0.564	49.15	14.79	18.63	138.98	79.90	62.76	13.20	41.55	24.49	17.16	3.96
	C3 (5)		1.689	0.491	0.568	49.96	15.09	18.96	139.80	81.69	63.30	13.28	42.19	25.76	19.10	4.03
	C4 (7.5)		1.703	0.498	0.575	51.09	15.42	19.37	141.07	82.95	65.19	13.47	42.93	26.76	20.76	4.10
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**

Table (4): Effect of different treatments on macronutrients concentration (%), uptake (Kg fed^{-1}) and DTPA- extractable metals of barley grains in the second season (winter 2017/2018).

Application depth cm	Nitrogen fertilizer	Compost Rates (ton fed^{-1})	Macronutrients						DTPA- extractable micronutrients (mg Kg^{-1})				Micronutrients			
			Concentration, %			Uptake, Kg fed^{-1}							Uptake, g fed^{-1}			
			N	P	K	N	P	K	Fe	Zn	Mn	Cu	Fe	Zn	Mn	Cu
D1	N1	C1	1.313	0.286	0.388	27.01	7.26	8.54	121.30	70.89	40.19	10.73	28.61	14.66	8.34	1.97
		C2	1.342	0.350	0.415	28.45	7.81	9.56	126.40	72.11	43.33	10.98	33.33	16.86	9.43	2.21
		C3	1.349	0.352	0.419	28.62	7.88	9.76	127.12	73.37	43.48	11.02	33.64	17.15	9.89	2.26
		C4	1.355	0.356	0.426	29.07	8.03	9.91	128.32	73.94	43.82	11.06	34.39	17.34	10.64	2.29
	N2	C1	1.333	0.344	0.409	28.05	7.67	9.33	125.05	72.07	42.80	10.92	32.08	16.37	9.18	2.18
		C2	1.436	0.398	0.497	33.41	9.58	12.33	140.29	75.40	56.35	11.63	40.76	20.59	13.86	2.81
		C3	1.440	0.401	0.500	33.67	9.69	12.46	140.68	77.63	56.54	11.65	41.21	20.73	14.07	2.92
		C4	1.451	0.406	0.506	34.03	9.82	12.75	142.21	78.18	56.88	11.70	42.44	21.08	15.38	2.96
	N3	C1	1.418	0.389	0.479	32.26	9.20	11.67	137.12	75.26	55.62	11.49	38.94	19.82	13.14	2.70
		C2	1.518	0.435	0.556	38.16	11.23	14.57	150.27	78.02	59.33	12.16	50.33	24.03	15.29	3.62
		C3	1.527	0.437	0.560	38.45	11.33	14.74	151.43	80.19	59.53	12.21	50.65	25.23	16.54	3.70
		C4	1.534	0.442	0.568	39.06	11.50	15.08	152.36	81.77	59.84	12.25	51.61	26.66	17.71	3.85
	N4	C1	1.497	0.426	0.540	36.63	10.69	13.91	147.64	80.80	58.54	12.02	47.40	23.08	15.55	3.23
		C2	1.876	0.516	0.603	45.07	12.67	17.47	159.63	83.93	62.03	12.70	58.75	27.56	17.10	4.20
		C3	1.889	0.523	0.608	45.73	12.88	17.83	161.03	86.64	62.43	12.77	60.09	28.05	18.36	4.24
		C4	1.934	0.549	0.622	48.36	13.88	18.12	166.14	90.33	63.25	12.93	61.58	29.12	19.73	4.32
D2	N1	C1	1.320	0.336	0.395	27.49	7.44	8.94	122.30	71.89	41.69	10.81	29.66	15.26	8.60	2.04
		C2	1.372	0.365	0.440	29.69	8.27	10.35	130.68	73.93	43.47	11.19	35.72	16.81	9.95	2.36
		C3	1.379	0.368	0.444	30.07	8.39	10.56	131.50	74.38	45.71	11.23	36.10	17.01	10.09	2.43
		C4	1.387	0.373	0.452	30.77	8.63	10.81	132.85	75.70	55.29	11.28	36.76	18.30	12.33	2.47
	N2	C1	1.363	0.361	0.432	29.29	8.14	10.14	129.50	74.29	45.06	11.12	34.84	16.55	9.78	2.34
		C2	1.457	0.409	0.511	34.26	9.90	12.87	142.59	76.42	58.07	11.73	42.65	21.19	12.48	2.98
		C3	1.465	0.412	0.519	34.90	10.09	13.18	143.47	78.08	58.43	11.80	43.76	21.73	13.69	3.03

		C4	1.470	0.414	0.523	35.17	10.18	13.26	144.02	79.29	58.65	11.84	44.62	22.00	14.89	3.09
	N3	C1	1.423	0.392	0.486	32.55	9.31	11.93	138.30	76.65	56.86	11.54	39.85	20.21	13.63	2.75
		C2	1.539	0.445	0.573	39.23	11.57	15.23	152.84	79.06	61.07	12.31	52.98	24.85	16.86	3.90
		C3	1.546	0.448	0.577	39.76	11.75	15.61	153.99	81.61	61.40	12.36	54.09	26.30	17.99	3.94
		C4	1.554	0.454	0.585	40.11	11.94	16.09	155.00	83.97	61.67	12.42	55.22	27.56	19.21	3.99
	N4	C1	1.503	0.429	0.544	37.23	10.92	14.06	148.83	81.28	59.80	12.05	48.10	23.50	15.88	3.27
		C2	1.960	0.567	0.636	50.48	14.84	18.57	170.20	85.38	64.87	13.04	62.83	28.00	19.10	4.41
		C3	1.974	0.574	0.643	51.37	15.01	18.93	172.11	88.01	65.31	13.12	64.43	29.29	21.39	4.47
		C4	1.996	0.585	0.651	52.79	15.54	19.41	174.50	91.95	65.77	13.20	65.86	30.78	23.80	4.55
A Application depth cm	D1 (surface)		1.513	0.413	0.506	35.38	10.07	13.00	142.31	78.16	54.00	11.76	44.11	21.77	14.01	3.09
	D2 (30 cm)		1.544	0.433	0.526	37.20	10.75	13.75	146.42	79.49	56.45	11.94	46.72	22.46	14.98	3.25
	F - test		**	*	*	*	**	*	**	**	*	**	*	*	**	**
B Nitrogen fertilizer	N1 (0%)		1.352	0.348	0.422	28.90	7.96	9.80	127.56	73.28	44.62	11.04	33.53	16.67	9.91	2.25
	N2 (50%)		1.427	0.393	0.487	32.85	9.38	12.04	138.48	76.42	54.10	11.55	40.30	20.03	12.92	2.79
	N3 (75%)		1.507	0.430	0.548	37.45	10.98	14.37	148.91	79.57	59.42	12.09	49.21	24.33	16.30	3.56
	N4 (100%)		1.829	0.521	0.606	45.96	13.30	17.29	162.51	86.04	62.75	12.73	58.63	27.42	18.86	4.09
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1 (0)		1.396	0.370	0.459	31.31	8.83	11.07	133.76	75.39	50.07	11.34	37.44	18.68	11.76	2.56
	C2 (2.5)		1.563	0.436	0.529	37.34	10.73	13.87	146.61	78.03	56.07	11.97	47.17	22.49	14.26	3.31
	C3 (5)		1.571	0.439	0.534	37.82	10.88	14.13	147.67	79.99	56.60	12.02	48.00	23.19	15.25	3.37
	C4 (7.5)		1.585	0.447	0.542	38.67	11.19	14.43	149.43	81.89	58.15	12.09	49.06	24.11	16.71	3.44
	F - test		**	**	**	**	**	**	**	**	**	**	**	**	**	**

Regarding the application depth, the results indicated that the values of N, P and K concentrations and its uptake by maize and barley grains were significantly increased by increasing the application depth to 30 cm depth, where the use of 30 cm mole depth was more effective than surface depth. The highest values of N, P and K concentrations and its uptake were reached to 1.661 and 1.544 %, 48.99 and 37.20 kg fed^{-1} for N concentration and uptake, 0.483 and 0.433 %, 14.66 and 10.75 kg fed^{-1} for P concentration and uptake and 0.562 and 0.526 %, 18.43 and 13.75 kg fed^{-1} for K concentration and uptake, by maize and barley grains at 30 cm mole depth in the first and second seasons, respectively.

The results reveal that increasing nitrogen fertilizer rates addition to 100 % of the recommended dose led to significantly increases N, P and K concentrations and its uptake by maize and barley grains to be 1.964 and 1.829 %, 60.67 and 45.96 kg fed^{-1} for N concentration and uptake, 0.580 and 0.521 %, 18.60 and 13.30 kg fed^{-1} for P concentration and uptake and 0.631 and 0.606 %, 23.47 and 17.29 kg fed^{-1} for K concentration and uptake, by maize and barley grains, respectively.

Also, the values of N, P and K concentrations and its uptake by maize and barley grains were significantly increased with increasing compost rates addition, where the highest values were recorded by the addition of 7.5 ton compost fed^{-1}. The highest values were reached to 1.703 and 1.585 %, 51.09 and 38.67 kg fed^{-1} for N, 0.498 and 0.447 %, 15.42 and 11.19 kg fed^{-1} for P and 0.575 and 0.542 %, 19.37 and 14.43 kg fed^{-1} for K concentration and uptake, by maize and barley grains, in the first and second seasons, respectively. Similar results were obtained by Mostafa (2001), Abd-Allah (2014) and El-Sodany *et al.* (2015). These results may be due to the ability of compost addition in maintain soil nutrients to be more available and chelation of these elements by humic substances. Consequently, help to increase the respiration rate, metabolism and plant growth, causing more require nutrients for plants from soil or fertilizers, as mentioned by Sinha (1972) who suggested that the organic acids are produced during the decomposition of organic matter in soils influence the pH and consequently rendered available P from calcium phosphate. Also, similar results were obtained by Derar and Eid (1996), they reported that the concentrations of N, P and K in wheat and corn grains were increased upon increasing sludge application.

2- Micronutrient concentrations and uptake by maize and barley grains.

Data in Tables (3 and 4) indicate that all different treatments led to increase micronutrient concentrations and its uptake by maize and barley grains in the two seasons. The highest values of Fe, Zn, Mn and Cu concentrations and uptake 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, where the increases values were reached to 159.55, 92.09, 78.27 and 15.47 mg Kg^{-1}, 54.83, 35.42, 29.54 and 5.36 g fed^{-1} in the first season and reached to 174.50, 91.95, 65.77 and 13.20 mg Kg^{-1}, 65.86, 30.78, 23.80 and 4.55 g fed^{-1} in the second one for their concentrations and uptake by maize and barley grains, respectively.

The results indicate that the values of Fe, Zn, Mn and Cu concentrations and its uptake by maize and barley grains were significantly increased by using 30 cm mole depth as compared with surface depth. The highest values were reached to 138.55, 81.12, 62.44 and 13.68 mg Kg^{-1}, 41.14, 24.92, 19.54 and 3.93 g fed^{-1} in the first season and reached to 146.42, 79.49, 56.45 and 11.94 mg Kg^{-1}, 46.72, 22.46, 14.98 and 3.25 g fed^{-1} in the second one, respectively.

Concerning nitrogen fertilizer rates addition, the results indicate that the values of Fe, Zn, Mn and Cu concentrations and its uptake by maize and barley grains were significantly increased by increasing nitrogen fertilizer rates addition to 100 % of the recommended dose. The highest values of Fe, Zn, Mn and Cu concentrations and its uptake were increased to 151.27, 87.75, 73.40 and 14.17 mg Kg^{-1}, 50.17, 31.16, 23.28 and 4.89 g fed^{-1} in the first season and increased to 162.51, 86.04, 62.75 and 12.73 mg Kg^{-1}, 58.63, 27.42, 18.86 and 4.09 g fed^{-1} in the second one, respectively.

Also, the results indicate that increasing the addition rates of compost led to significant increases of Fe, Zn, Mn, Cu concentrations and its uptake by maize and barley grains, where the highest values were recorded by the addition of 7.5 ton compost fed^{-1}, where the highest values of their concentrations and uptake reached to 141.07, 82.95, 65.19 and 13.47 mg Kg^{-1}, 42.93, 26.76, 20.76 and 4.10 g fed^{-1} in the first season and reached to 149.43, 81.89, 58.15 and 12.09 mg Kg^{-1}, 49.06, 24.11, 16.71 and 3.44 g fed^{-1} in the second one, respectively. Similar results were obtained by Mostafa (2001). These results may be due to high content of Fe, Zn, Mn and Cu in the compost addition, Table (1-b), which enhanced some enzymes and other metabolism actions. Similar results were obtained by El-Fayoumy *et al.* (2000), who reported that sludge application may cause easily and gradual availability of micronutrients and heavy metals to the plants or may cause accumulation of these elements and subsequently biologically increase their absorption by plants. Similar conclusions were obtained also by El-Maddah (2005), who reported that the concentration of micronutrients in wheat and maize grains were increased with all combinations of added natural amendments.

It can be observed that Zn, Mn and Cu concentrations and uptake by maize grains in the first season were greater than its concentrations and uptake by barley grains in the second one, these results may be due to the high content of Zn, Mn, Cu in the compost rates addition which it added before maize planting in the first season only. On the contrary, the results indicate that Fe concentration and uptake by maize grains in the first season was less than by barley grains in the second one. This may be due to fixation and precipitation of iron, particularly in case of soil pH over neutral conditions. Also, this may be due to selectivity coefficient of these micronutrients under the conditions of investigated soil. Similar results were obtained by El-Fayoumy *et al.* (2000), who added that most of micronutrients and heavy metals are usually precipitated due to basic soil reaction or absorbed on colloidal organic and inorganic constituents when they are added to the soil, these processes usually affected their availability to plants.

3- Macronutrients concentration and its uptake by maize and barley straw.

Data in Tables (5 and 6) show that N, P and K concentrations and uptake by maize and barley straw were take the same trend of them with grains as mentioned before. Where, their values were increased with all treatments in the first and second seasons. The highest values of their concentrations were increased to 0.784, 0.267 and 0.368 %, 0.776, 0.251 and 0.357 % in the first and second seasons, respectively. While, the increases of their uptake were increased to 61.15, 14.02 and 20.88 Kg fed^{-1}, 34.10, 12.29 and 16.79 Kg fed^{-1} in the same seasons, where the highest values of N, P and K concentrations and uptake were recorded 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 results indicate that the values of N, P and K concentrations and uptake by maize and barley straw were significantly increased with increasing application depth, where the application at 30 cm mole depth was more effective than the application at surface depth. The highest values were reached to 0.670, 0.241 and 0.343 %, 39.50, 11.24 and 14.78 Kg fed^{-1} in the first season and reached to 0.605, 0.232 and 0.333 %, 24.15, 9.90 and 13.45 Kg fed^{-1} in the second one for N, P and K concentrations and its uptake, respectively.

Regarding the addition of nitrogen fertilizer rates, the results indicate that increasing nitrogen fertilizer rates to 100 % of the recommended dose led to significantly increases the values of N, P and K concentrations and uptake by maize and barley straw in the first and second seasons. The highest values of N, P and K concentrations and its uptake were reached to 0.736, 0.248 and 0.354 %, 53.15, 12.26 and 17.53 Kg fed^{-1} and reached to 0.705, 0.240 and 0.342 %, 30.70, 11.02 and 15.43 Kg fed^{-1} in the first and second seasons, respectively.

Also, the results indicate that the values of N, P and K concentrations and uptake by maize and barley straw were significantly increased by increasing compost rates addition. The highest values of N, P and K concentrations and uptake by maize and barley straw were recorded by the addition of 7.5 ton compost fed^{-1}. The highest values of N, P and K concentrations were reached to 0.681, 0.242 and 0.350 %, 0.622, 0.232 and 0.343 % of the two seasons, respectively. While, the highest values of N, P and K uptake by maize and barley straw were reached to 42.09, 11.58 and 15.85 Kg fed^{-1}, 25.48, 9.86 and 13.96 Kg fed^{-1} of the two seasons, respectively. These results are in line with Sowicki (2003).

Table (5): Effect of different treatments on macronutrients concentration (%), uptake (Kg fed^{-1}) and DTPA- extractable metals of maize straw in the first season (summer 2017).

Application depth cm	Nitrogen fertilizer	Compost Rates (ton fed^{-1})	Macronutrients						DTPA- extractable micronutrients (mg Kg^{-1})				Micronutrients			
			Concentration, %			Uptake, Kg fed^{-1}							Uptake, g fed^{-1}			
			N	P	K	N	P	K	Fe	Zn	Mn	Cu	Fe	Zn	Mn	Cu
D1	N1	C1	0.561	0.215	0.296	21.34	8.12	10.84	143.12	69.10	83.87	11.69	49.88	22.93	26.56	3.74
		C2	0.584	0.221	0.323	23.52	9.11	11.73	145.83	71.26	86.20	11.90	52.70	26.18	28.60	3.92
		C3	0.588	0.223	0.327	23.65	9.20	11.84	145.92	71.31	86.30	11.92	52.95	27.79	29.81	3.97
		C4	0.591	0.224	0.330	24.51	9.56	12.55	146.81	72.04	88.31	11.95	54.85	28.66	31.81	4.08
	N2	C1	0.579	0.217	0.317	22.84	8.81	11.11	145.00	70.57	84.35	11.85	51.16	25.43	27.94	3.82
		C2	0.644	0.228	0.335	33.49	9.64	12.45	154.39	78.23	88.79	12.45	56.28	30.47	33.52	4.19
		C3	0.646	0.229	0.338	33.86	9.82	12.78	154.53	78.27	88.84	12.48	57.09	31.53	34.34	4.27
		C4	0.649	0.232	0.344	35.26	10.53	14.01	155.11	78.77	90.21	12.51	59.86	33.26	37.63	4.46
	N3	C1	0.629	0.219	0.328	30.83	9.49	12.14	152.13	76.33	87.61	12.32	54.56	28.69	31.28	4.17
		C2	0.689	0.235	0.342	43.50	10.62	13.55	160.73	83.38	94.31	12.93	59.17	31.72	36.90	4.25
		C3	0.693	0.239	0.348	44.53	11.07	14.43	161.17	83.66	95.03	13.00	61.26	32.47	39.28	4.44
		C4	0.698	0.242	0.354	46.38	11.87	16.05	162.05	84.44	97.08	13.06	65.06	35.53	43.54	4.73
	N4	C1	0.677	0.227	0.337	40.50	10.92	14.98	158.90	81.84	90.26	12.82	58.92	31.91	35.61	4.37
		C2	0.730	0.242	0.346	53.56	11.48	16.44	166.05	87.59	99.34	13.41	61.42	35.39	38.54	4.50
		C3	0.737	0.247	0.356	55.67	12.09	18.11	166.98	88.36	101.42	13.48	65.76	38.28	43.73	4.63
		C4	0.742	0.250	0.361	55.72	12.38	18.50	167.05	88.39	101.45	13.51	69.82	39.01	45.77	4.67
D2	N1	C1	0.567	0.219	0.304	21.71	8.29	11.15	143.50	69.38	85.18	11.76	50.69	25.54	27.73	3.82
		C2	0.600	0.230	0.333	25.78	10.19	12.63	147.93	72.98	90.86	12.02	55.64	29.51	31.79	4.09
		C3	0.605	0.234	0.338	26.24	10.34	13.07	148.66	73.50	92.20	12.07	56.61	30.60	32.77	4.19
		C4	0.610	0.236	0.343	27.46	10.86	14.12	149.45	74.21	94.15	12.10	59.37	31.95	34.68	4.38
	N2	C1	0.595	0.228	0.326	24.82	9.70	12.81	147.11	72.27	88.91	11.98	55.57	28.47	29.57	3.95
		C2	0.654	0.235	0.338	35.51	10.60	13.08	155.62	79.18	95.20	12.57	60.55	32.82	35.11	4.34

		C3	0.657	0.236	0.343	36.40	11.02	14.12	156.28	79.74	96.75	12.60	62.33	34.51	38.34	4.47
		C4	0.660	0.237	0.346	36.90	11.28	14.59	156.40	79.81	96.86	12.63	63.48	35.64	39.38	4.57
	N3	C1	0.633	0.232	0.332	31.91	10.91	13.02	152.88	76.97	93.45	12.35	58.88	31.63	33.91	4.22
		C2	0.705	0.246	0.344	47.34	11.44	14.01	162.79	84.97	98.45	13.13	62.94	34.42	39.88	4.50
		C3	0.709	0.248	0.350	48.79	11.88	15.53	163.55	85.67	100.27	13.19	64.80	36.77	43.26	4.72
		C4	0.714	0.250	0.357	49.35	12.16	16.06	163.79	85.78	100.55	13.22	67.95	37.78	45.61	4.83
	N4	C1	0.680	0.239	0.343	41.87	11.61	15.09	159.52	82.37	97.63	12.85	61.56	33.63	36.95	4.57
		C2	0.767	0.255	0.355	57.84	12.35	17.28	170.65	91.27	103.05	13.80	63.92	37.04	42.82	4.60
		C3	0.773	0.259	0.365	58.91	13.20	18.97	171.66	92.08	105.15	13.88	66.07	39.26	45.41	4.78
		C4	0.784	0.267	0.368	61.15	14.02	20.88	173.01	93.15	107.96	14.01	70.32	42.18	47.68	5.02
A Application depth cm	D1 (surface)			0.231	0.336	36.82	10.29	13.84	155.36	78.97	91.46	12.58	58.17	31.20	35.30	4.26
	D2 (30 cm)			0.241	0.343	39.50	11.24	14.78	157.68	80.83	96.66	12.76	61.29	33.86	37.81	4.44
	F - test			*	*	**	**	**	**	**	**	**	*	**	**	*
B Nitrogen fertilizer	N1 (0%)			0.225	0.324	24.28	9.46	12.24	146.40	71.72	88.38	11.93	54.09	27.90	30.47	4.02
	N2 (50%)			0.230	0.336	32.39	10.18	13.12	153.06	77.11	91.24	12.38	58.29	31.52	34.48	4.26
	N3 (75%)			0.239	0.344	42.83	11.18	14.35	159.89	82.65	95.84	12.90	61.83	33.63	39.21	4.48
	N4 (100%)			0.248	0.354	53.15	12.26	17.53	166.73	88.13	100.78	13.47	64.72	37.09	42.06	4.64
	F - test			**	**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1 (0)			0.225	0.323	29.48	9.73	12.64	150.27	74.85	88.91	12.20	55.15	28.53	31.19	4.08
	C2 (2.5)			0.237	0.340	40.07	10.68	13.90	158.00	81.11	94.53	12.78	59.08	32.19	35.90	4.30
	C3 (5)			0.239	0.346	41.01	11.08	14.86	158.59	81.57	95.75	12.83	60.86	33.90	38.37	4.43
	C4 (7.5)			0.242	0.350	42.09	11.58	15.85	159.21	82.07	97.07	12.87	63.84	35.50	40.76	4.59
	F - test			**	**	**	**	**	**	**	**	**	**	**	**	**

4- Micronutrient concentrations and uptake by maize and barley straw.

Data in Tables (5 and 6) show the Fe, Zn, Mn and Cu concentrations and uptake by maize and barley straw, where the results indicate that their concentrations and uptake gave similar trend as maize and barley grains, where all treatments led to markedly increases in their concentrations and uptake. It can be noticed that the addition of 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % recommended dose of nitrogen fertilizer for each crop gave the highest values of Fe, Zn, Mn and Cu concentrations and their uptake by maize and barley straw. The values were increased to 173.01, 93.15, 107.96 and 14.01 mg Kg^{-1}, 70.32, 42.18, 47.68 and 5.02 g fed^{-1} in the first season and increased to 170.16, 82.37, 96.03 and 13.89 mg Kg^{-1}, 66.46, 36.06, 42.02 and 4.72 g fed^{-1} in the second one for Fe, Zn, Mn and Cu concentrations and its uptake, respectively.

The results reveal that increasing application depth to 30 cm led to significantly increases of Fe, Zn, Mn and Cu concentrations and uptake by maize and barley straw. The highest values of their concentrations and uptake were reached to 157.68, 80.83, 96.66 and 12.76 mg Kg^{-1}, 61.29, 33.86, 37.81 and 4.44 g fed^{-1} in the first season and reached to 154.74, 71.75, 85.29 and 12.69 mg Kg^{-1}, 55.92, 28.56, 33.59 and 4.24 g fed^{-1} in the second one, respectively.

Concerning nitrogen fertilizer rates addition, the results reveal that increasing nitrogen fertilizer rates to 100 % of the recommended dose led to significantly increases Fe, Zn, Mn and Cu concentrations and its uptake by maize and barley grains, where the highest values were reached to 166.73, 88.13, 100.78 and 13.47 mg Kg^{-1}, 64.72, 37.09, 42.06 and 4.64 89 g fed^{-1} in the first season and reached to 163.87, 77.93, 91.56 and 13.38 mg Kg^{-1}, 59.38, 33.66, 37.84 and 4.38 g fed^{-1} in the second one, respectively.

Also, the results clear that increasing the addition rates of compost obtained significantly increases of Fe, Zn, Mn and Cu concentrations and its uptake by maize and barley grains, where the highest values were recorded by the addition of 7.5 ton compost fed^{-1}. The highest values of N, P and K concentrations were increased to 159.21, 82.07, 97.07 and 12.87 mg Kg^{-1}, 63.84, 35.50, 40.76 and 4.59 g fed^{-1} in the first season and increased to 156.29, 72.75, 86.34 and 12.81 mg Kg^{-1}, 56.99, 30.45, 35.87 and 4.30 g fed^{-1} in the second one, respectively. It could be observed that the concentrations and uptake of Fe, Zn, Mn and Cu of barley straw were less in the second season than with maize straw in the first one. These results may be as a result of added compost before maize planting only in the first season. Similar results were obtained by El-Sodany *et al.* (2015). Generally, the concentration of micronutrients in maize and barley grains and straw were within the normal ranges as stated by Hausenbuiller (1985). It could be recommended to use 7.5 ton compost fed^{-1} in 30 cm mole depth to increase the availability of macro and micronutrients for plants

Table (6): Effect of different treatments on macronutrients concentration (%), uptake (Kg fed^{-1}) and DTPA- extractable metals of barley straw in the second season (winter 2017/2018).

Application depth cm	Nitrogen fertilizer	Compost Rates (ton fed^{-1})	Macronutrients						DTPA- extractable micronutrients (mg Kg^{-1})				Micronutrients			
			Concentration, %			Uptake, Kg fed^{-1}							Uptake, g fed^{-1}			
			N	P	K	N	P	K	Fe	Zn	Mn	Cu	Fe	Zn	Mn	Cu
D1	N1	C1	0.443	0.209	0.289	13.68	6.98	8.18	140.07	62.37	75.49	11.61	42.04	18.71	22.66	3.48
		C2	0.476	0.215	0.313	15.93	7.77	10.74	142.78	63.92	77.23	11.84	45.03	20.06	24.44	3.90
		C3	0.480	0.216	0.317	16.00	7.82	10.82	142.84	64.00	77.29	11.88	47.12	21.12	25.50	3.92
		C4	0.486	0.217	0.321	16.46	7.92	11.32	143.75	64.49	77.86	11.90	49.87	23.49	26.93	3.97
	N2	C1	0.466	0.214	0.299	15.44	7.65	10.03	141.92	63.45	76.69	11.77	44.15	20.64	24.94	3.64
		C2	0.566	0.222	0.324	21.77	8.39	11.99	151.48	69.11	82.93	12.42	53.19	25.09	29.36	3.91
		C3	0.568	0.223	0.329	22.00	8.47	12.36	151.54	69.29	83.00	12.46	53.58	26.16	31.57	4.07
		C4	0.573	0.224	0.332	22.52	8.57	13.00	152.17	69.70	83.44	12.49	54.40	27.65	32.06	4.20
	N3	C1	0.545	0.218	0.318	20.10	8.97	11.98	149.11	67.81	81.41	12.31	50.21	24.63	27.60	3.69
		C2	0.634	0.225	0.335	26.65	9.59	12.22	157.90	73.91	87.30	12.88	56.65	28.15	31.83	4.11
		C3	0.641	0.227	0.342	27.11	9.70	12.54	158.28	74.20	87.59	12.94	57.24	30.41	34.21	4.18
		C4	0.650	0.229	0.351	27.84	9.84	13.26	159.21	74.79	88.24	13.00	58.28	31.13	36.84	4.25
	N4	C1	0.616	0.225	0.327	25.05	9.22	12.18	156.01	72.21	86.01	12.74	54.18	28.82	31.36	4.13
		C2	0.695	0.238	0.337	31.01	10.64	15.60	163.18	77.44	91.06	13.32	58.70	33.75	34.62	4.21
		C3	0.706	0.240	0.342	31.70	10.76	16.00	164.15	78.06	91.71	13.38	59.71	34.31	38.26	4.27
		C4	0.712	0.241	0.350	31.98	10.80	16.46	164.18	78.11	91.78	13.42	53.78	36.48	41.31	4.31
D2	N1	C1	0.451	0.213	0.292	14.24	7.21	9.78	140.43	62.61	75.75	11.68	43.36	19.33	23.39	3.62
		C2	0.498	0.220	0.323	17.29	8.15	11.40	144.93	65.17	78.61	12.00	47.45	22.21	26.78	3.87
		C3	0.507	0.221	0.325	17.51	8.24	11.79	145.57	65.58	79.06	12.04	49.70	24.40	28.99	3.93
		C4	0.515	0.223	0.334	18.39	8.49	12.78	146.46	66.07	79.61	12.07	51.39	25.20	30.95	4.04
	N2	C1	0.492	0.219	0.308	16.71	8.01	11.68	144.05	64.69	78.07	11.94	46.34	21.72	26.20	3.82
		C2	0.582	0.221	0.331	22.79	9.66	12.23	152.67	70.06	83.79	12.51	56.78	26.79	30.30	4.26
		C3	0.587	0.227	0.338	23.17	9.72	12.96	153.37	70.47	84.22	12.53	57.25	27.29	34.55	4.29

		C4	0.590	0.231	0.341	23.44	9.82	13.18	153.46	70.55	84.31	12.57	59.81	29.39	36.94	4.34
	N3	C1	0.550	0.229	0.323	20.81	9.13	12.92	149.91	68.14	81.88	12.27	53.53	25.13	30.36	4.17
		C2	0.658	0.240	0.338	28.27	10.94	13.79	159.91	75.26	88.73	13.07	58.72	31.46	34.15	4.39
		C3	0.665	0.242	0.345	28.89	11.12	14.54	160.76	75.78	89.33	13.11	59.73	33.90	37.76	4.46
		C4	0.670	0.243	0.354	29.12	11.17	14.87	160.90	75.93	89.44	13.15	61.96	34.23	39.91	4.54
	N4	C1	0.621	0.233	0.330	25.68	10.35	14.09	156.65	73.07	86.48	12.80	57.12	29.49	34.90	4.38
		C2	0.750	0.245	0.344	32.70	11.98	16.04	167.80	80.75	94.32	13.69	61.81	34.98	38.98	4.48
		C3	0.761	0.248	0.351	33.34	12.09	16.28	168.81	81.44	95.05	13.78	63.28	35.35	41.30	4.54
		C4	0.776	0.251	0.357	34.10	12.29	16.79	170.16	82.37	96.03	13.89	66.46	36.06	42.02	4.72
A Application depth cm	D1 (surface)			0.224	0.327	22.83	8.94	12.42	152.41	70.18	83.69	12.52	52.38	26.91	30.84	4.02
	D2 (30 cm)			0.232	0.333	24.15	9.90	13.45	154.74	71.75	85.29	12.69	55.92	28.56	33.59	4.24
	F - test			**	*	*	*	**	**	**	**	**	**	*	*	**
B Nitrogen fertilizer	N1 (0%)			0.217	0.314	16.19	7.82	10.85	143.35	64.28	77.61	11.88	47.00	21.82	26.21	3.84
	N2 (50%)			0.223	0.325	20.98	8.79	12.18	150.08	68.42	82.06	12.34	53.19	25.59	30.74	4.07
	N3 (75%)			0.232	0.338	26.10	10.06	13.27	157.00	73.23	86.74	12.84	57.04	29.88	34.08	4.22
	N4 (100%)			0.240	0.342	30.70	11.02	15.43	163.87	77.93	91.56	13.38	59.38	33.66	37.84	4.38
	F - test			**	**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1 (0)			0.220	0.311	18.96	8.44	11.36	147.27	66.79	80.22	12.14	48.87	23.56	27.68	3.87
	C2 (2.5)			0.228	0.331	24.55	9.64	13.00	155.08	71.95	85.50	12.72	54.79	27.81	31.31	4.14
	C3 (5)			0.231	0.336	24.97	9.74	13.41	155.67	72.35	85.91	12.77	55.95	29.12	34.02	4.21
	C4 (7.5)			0.232	0.343	25.48	9.86	13.96	156.29	72.75	86.34	12.81	56.99	30.45	35.87	4.30
	F - test			**	**	**	**	**	**	**	**	**	**	**	**	**

IV- Effect of different treatments on yield and yield components:

Most of the growth characters of maize and barley plants were significantly affected by either the application depth or the addition of nitrogen fertilizer and compost rates. Results in Tables (7 and 8) show these effects on yield and yield components of maize and barley plants where their responses to these treatments were always the same trend, which could be noticed from these tables.

The results in Tables (7 and 8) indicated that all different treatments led to significantly differences on yield and yield components at the end of the two seasons. The increases of the application depth or nitrogen fertilizer and compost rates addition led to significant increases in the yield, where the highest yield of maize in the first season (3.3787 ton fed^{-1}) and barley in the second season (2.9327 ton fed^{-1}) were obtained by the addition of 7.5 ton compost fed^{-1} in 30 cm mole depth with 100 % of the recommended dose nitrogen fertilizer. Also, the same treatment attained increases in plant height, ear length, ear diameter, number of rows per ear, number of kernels per row, 100 seed weight and dry matter g $plant^{-1}$ for maize in the first season and in biological yield, straw yield, plant height, spike length, harvest index, 1000 seed weight, number of spikes per m^2 and dry matter g (10 $plants)^{-1}$ for barley in the second one.

Concerning the effect of application depth, the mean values of yield and yield components showed that all the studied characters were increased during the two seasons with increasing the soil depth. The grain yield values obtained by using 30 cm mole depth was greater than surface depth, where differed from 2.4560 to 2.5356 and 2.2397 to 2.3399 ton fed^{-1} for maize and barley grains yield in the first and second seasons, respectively. These results are in line with those reported by El-Sodany *et al.* (2016)

With respect to the addition of nitrogen fertilizer, data in Tables (7 and 8) indicated that all growth characters under study of maize and barley plants were significantly affected by the addition of nitrogen fertilizer rates. The results showed that increasing of nitrogen fertilizer rates led to significant differences on yield and yield components at the end of the two seasons. The highest yield values of maize and barley were obtained by the addition of 100 % of the recommended dose nitrogen fertilizer for each crop, where they increased to 3.1803 and 2.7044 ton fed^{-1}, respectively. Also, the same treatment attained significant increases in plant height, ear length, ear diameter, number of rows per ear, number of kernels per row, 100 seed weight and dry matter g $plant^{-1}$ for maize in the first season and in biological yield, straw yield, plant height, spike length, harvest index, 1000 seed weight, number of spikes per m^2 and dry matter g (10 $plants)^{-1}$ for barley in the second one. Similar results were obtained by Barabasz *et al.* (2002), also, Meena *et al.* (2015) indicated that grain yield of maize was significantly higher in the treatments of recommended dose of fertilizers and vermicompost equivalent to 120 kg N/ha

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Table (7): Effect of different treatments on maize yield and growth characters in the first season (summer 2017).

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed^{-1})	Plant height, cm	Ear length, cm	Ear diameter, cm	No. of rows per ear	No. of kernels per row	100 seed weight, g	Grain yield, Ton fed^{-1}	R.I.G.Y.	Dry matter, g/plant after 80 days
D1	N1	C1	168.00	11.38	2.53	7.58	16.72	21.78	1.6135	0.00	92.00
		C2	173.75	13.71	3.15	9.56	24.23	29.91	1.7635	9.30	126.17
		C3	177.34	14.25	3.18	9.67	24.46	30.76	1.7911	11.01	130.52
		C4	179.54	14.58	3.40	10.75	26.65	31.37	1.8072	12.00	133.08
	N2	C1	171.99	13.46	2.97	9.53	21.84	28.92	1.7430	8.03	120.77
		C2	192.70	16.74	3.91	11.17	33.33	37.35	2.2493	39.41	159.59
		C3	193.22	17.00	3.93	11.23	33.42	38.21	2.2658	40.43	162.30
		C4	194.38	17.03	3.95	11.64	34.55	38.96	2.2890	41.87	164.43
	N3	C1	190.49	16.33	3.82	11.03	32.36	36.22	2.1487	33.17	151.56
		C2	205.65	18.45	4.27	12.44	39.20	42.43	2.9610	83.51	193.24
		C3	207.11	18.84	4.29	12.52	39.28	43.23	3.0168	86.97	197.40
		C4	209.44	19.21	4.34	12.57	39.58	43.66	3.0411	88.48	200.87
	N4	C1	202.26	18.00	4.24	12.36	38.71	41.18	2.8520	76.76	182.95
		C2	216.02	20.25	4.51	12.92	42.50	47.34	3.2197	99.55	228.63
		C3	217.50	20.75	4.52	12.96	43.10	47.94	3.2232	99.76	235.48
		C4	218.27	21.76	4.53	13.52	43.28	48.42	3.3118	105.26	240.83
D2	N1	C1	168.25	12.69	2.63	7.89	18.11	25.17	1.7007	5.40	97.37
		C2	181.77	14.99	3.55	10.80	29.01	32.99	1.8527	14.82	138.00
		C3	182.36	15.14	3.58	10.83	29.79	33.43	1.8684	15.80	139.73
		C4	184.20	15.34	3.60	10.85	30.03	34.09	1.8904	17.16	142.16
	N2	C1	180.61	14.85	3.43	10.77	27.26	31.99	1.8354	13.75	135.79
		C2	195.92	17.08	3.98	11.68	34.83	39.31	2.3407	45.07	166.86
		C3	196.94	17.12	4.09	12.23	36.60	39.56	2.3622	46.40	168.50

		C4	197.71	17.18	4.11	12.26	37.11	39.87	2.3759	47.25	171.11
	N3	C1	192.03	16.55	3.84	11.08	32.83	36.65	2.1772	34.94	153.31
		C2	209.93	19.25	4.35	12.68	39.89	44.33	3.0604	89.67	203.22
		C3	210.20	19.35	4.36	12.70	40.54	44.58	3.0915	91.60	205.48
		C4	211.54	19.42	4.37	12.72	40.75	45.14	3.1789	97.02	207.87
	N4	C1	203.28	18.25	4.25	12.41	38.80	41.42	2.8777	78.35	186.94
		C2	222.74	22.00	4.58	13.54	43.75	49.02	3.2464	101.20	248.10
		C3	226.70	22.41	4.59	13.58	44.09	49.97	3.3325	106.54	255.54
		C4	229.76	22.75	4.69	13.68	44.41	51.13	3.3787	109.40	270.65
A Application depth cm	D1		194.85	16.98	3.85	11.34	33.33	37.98	2.4560	52.22	169.99
	D2		199.62	17.77	4.00	11.86	35.49	39.92	2.5356	57.15	180.66
	F - test		**	*	**	**	*	*	*	**	**
B Nitrogen fertilizer	N1		176.90	14.01	3.20	9.74	24.88	29.94	1.7859	10.69	124.88
	N2		190.43	16.31	3.80	11.31	32.37	36.77	2.1827	35.28	156.17
	N3		204.55	18.43	4.21	12.22	38.05	42.03	2.8345	75.67	189.12
	N4		217.07	20.77	4.49	13.12	42.33	47.05	3.1803	97.10	231.14
	F - test		**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1		184.61	15.19	3.46	10.33	28.33	32.92	2.1185	31.30	140.09
	C2		199.81	17.81	4.04	11.85	35.84	40.34	2.5867	60.32	182.98
	C3		201.42	18.11	4.07	11.97	36.41	40.96	2.6189	62.31	186.87
	C4		203.11	18.41	4.12	12.25	37.05	41.58	2.6591	64.81	191.38
F - test			**	**	**	**	**	**	**	**	**

Table (8): Effect of different treatments on barley yield and growth characters in the second season (winter 2017/2018).

Application depth cm	Nitrogen fertilizer	Compost rates (ton fed^{-1})	Biological yield Ton fed^{-1}	Grain yield Ton fed^{-1}	Straw yield Ton fed^{-1}	R.I.G.Y	R.I.S.Y	Plant height, cm	Spike length, cm	Harvest Index,%	1000 Seed weight, g	No. of spikes per m^2	No. of kernels per spike	Dry matter, g/10 plants after 90 days
D1	N1	C1	3.2651	1.6689	1.5962	0.00	0.00	52.47	7.04	51.11	36.42	181.25	25.55	40.19
		C2	4.0110	1.8763	2.1347	12.43	33.74	70.16	9.92	46.78	37.48	237.18	30.96	42.94
		C3	4.0671	1.8797	2.1874	12.63	37.04	70.96	9.99	46.22	37.72	239.64	31.06	43.22
		C4	4.3071	1.8881	2.4190	13.13	51.55	72.22	10.05	43.84	38.06	245.87	31.99	43.62
	N2	C1	3.7736	1.7730	2.0006	6.24	25.34	67.83	9.81	46.98	37.23	232.02	30.23	42.76
		C2	5.0351	2.1501	2.8850	28.83	80.74	76.71	11.02	42.70	41.14	304.82	38.71	46.62
		C3	5.1129	2.1741	2.9388	30.27	84.11	77.33	11.08	42.52	41.48	305.62	38.91	46.83
		C4	5.1371	2.1873	2.9498	31.06	84.80	77.60	11.12	42.58	41.79	308.77	39.40	47.18
	N3	C1	4.7808	2.0547	2.7261	23.12	70.79	75.78	10.79	42.98	40.37	292.34	37.68	45.95
		C2	5.7745	2.4644	3.3101	47.67	107.37	80.66	11.41	42.68	44.34	353.02	42.35	49.52
		C3	5.8274	2.4773	3.3501	48.44	109.88	81.00	11.51	42.51	44.68	356.22	42.79	50.10
		C4	5.9412	2.5654	3.3758	53.72	111.49	82.23	11.53	43.18	44.82	359.45	43.00	50.39
	N4	C1	5.5690	2.3940	3.1750	43.45	98.91	79.60	11.38	42.99	43.53	340.18	41.60	48.78
		C2	6.7000	2.6630	4.0370	59.57	152.91	85.42	12.21	39.75	46.74	405.11	45.49	52.65
		C3	6.7898	2.7410	4.0488	64.24	153.65	86.20	12.34	40.37	46.97	408.97	46.26	52.91
		C4	6.9575	2.8777	4.0798	72.43	155.59	86.98	12.52	41.36	47.23	419.05	46.80	52.99
D2	N1	C1	3.7151	1.7340	1.9811	3.90	24.11	60.61	9.55	46.67	36.64	195.51	27.35	41.29
		C2	4.4106	1.9644	2.4462	17.71	53.25	73.57	10.23	44.54	38.55	257.88	34.03	44.25
		C3	4.4332	1.9822	2.4510	18.77	53.55	73.89	10.35	44.71	38.82	260.15	34.43	44.33
		C4	4.5027	1.9880	2.5147	19.12	57.54	74.48	10.41	44.15	39.04	270.48	35.35	44.51
	N2	C1	4.3869	1.9493	2.4376	16.80	52.71	72.94	10.12	44.43	38.21	250.71	32.49	43.97
		C2	5.2309	2.2060	3.0249	32.18	89.51	77.82	11.15	42.17	41.93	316.06	39.81	47.54

		C3	5.3684	2.2654	3.1030	35.74	94.40	78.19	11.16	42.20	42.28	318.63	40.25	47.73
		C4	5.4286	2.2997	3.1289	37.80	96.02	78.33	11.19	42.36	42.52	324.39	40.64	47.80
	N3	C1	4.8700	2.0874	2.7826	25.08	74.33	75.97	10.82	42.86	40.61	295.95	38.03	46.19
		C2	5.9892	2.5934	3.3958	55.40	112.74	82.35	11.56	43.30	45.17	365.30	43.10	50.77
		C3	6.0277	2.6064	3.4213	56.17	114.34	82.87	11.60	43.24	45.49	375.11	43.30	51.11
		C4	6.7490	2.8021	3.9469	67.90	147.27	82.99	11.63	41.52	45.63	379.69	43.71	51.71
	N4	C1	5.6634	2.4547	3.2087	47.08	101.02	80.06	11.39	43.34	43.85	343.08	41.66	49.03
		C2	6.7640	2.7010	4.0630	61.84	154.54	87.76	12.69	39.93	47.57	422.89	47.52	54.74
		C3	6.9970	2.8710	4.1260	72.03	158.49	88.30	12.78	41.03	47.72	435.25	47.82	55.21
		C4	7.1340	2.9327	4.2013	75.73	163.21	89.05	12.81	41.11	48.06	454.06	48.36	55.46
A Application depth cm	D1		5.1906	2.2397	2.9509	34.20	84.87	76.45	10.86	43.66	41.88	311.84	38.30	47.29
	D2		5.4794	2.3399	3.1396	40.20	96.69	78.70	11.22	42.97	42.63	329.07	39.87	48.48
	F - test		**	**	*	**	*	**	**	**	**	**	*	**
B Nitrogen fertilizer	N1		4.0890	1.8727	2.2163	12.21	38.85	68.55	9.69	46.00	37.84	236.00	31.34	43.04
	N2		4.9342	2.1256	2.8086	27.37	75.95	75.84	10.83	43.24	40.82	295.13	37.56	46.30
	N3		5.7450	2.4564	3.2886	47.19	106.03	80.48	11.36	42.78	43.89	347.14	41.75	49.47
	N4		6.5718	2.7044	3.8675	62.05	142.29	85.42	12.27	41.24	46.46	403.57	45.69	52.72
	F - test		**	**	**	**	**	**	**	**	**	**	**	**
C Compost rates (ton)	C1		4.5030	2.0145	2.4885	20.71	55.90	70.66	10.11	45.17	39.61	266.38	34.32	44.77
	C2		5.4894	2.3273	3.1621	39.45	98.10	79.31	11.27	42.73	42.87	332.78	40.25	48.63
	C3		5.5779	2.3746	3.2033	42.29	100.68	79.84	11.35	42.85	43.15	337.45	40.60	48.93
	C4		5.7697	2.4426	3.3270	46.36	108.43	80.49	11.41	42.51	43.39	345.22	41.16	49.21
	F - test		**	**	**	**	**	**	**	**	**	**	**	**

It can be noticed from Tables (7 and 8) that the compost rates addition led to relative increases in the yield and yield components in both seasons especially the addition of 7.5 ton compost fed^{-1}, since it recorded the highest values of maize and barley grain yield, where reached to 2.6591 and 2.4426 ton fed^{-1}, respectively. Also, the same treatment led to significant increases in all growth characters for maize and barley in the first and second seasons. These results are in agreement with those of Saraiya *et al.* (2005), Osman *et al.* (2014) and El-Sodany *et al.* (2016)

Thus, it can be confirmed that adapting mole depth in combination with adding compost is an important practice for enhancing the nutrient status of soil either macro or micronutrients for plants and accordingly increasing crop production comparable to untreated soil.

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أثر التسميد النتروجيني وإضافة معدلات من الكمبوست على أعماق مختلفة علي حالة بعض المغذيات الكبرى والصغرى في الأرض والنبات وعلي إنتاجية الذرة والشعير

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معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر.

أجريت تجارب حقلية خلال موسمين متعاقبين، الموسم الصيفي 2017 باستخدام محصول الذرة الشامية والموسم الشتوي 2018/2017 باستخدام محصول الشعير في محطة البحوث الزراعية بالجميزة، محافظة الغربية علي أرض طمية طينية لتقييم تأثير إضافة معدلات من الكمبوست علي سطح التربة، وفي أنفاق متوازية علي عمق 30 سم والمسافة بين هذه الأنفاق 3 متر مع معدلات من الأسمدة النتروجينية علي تيسير بعض العناصر الغذائية الكبرى والصغرى في التربة، والتركيب الكيميائي لنباتات الذرة والشعير وكذلك إنتاجية المحصول ومكوناته مع دراسة الأثر المتبقي لهذه المعاملات علي نفس الخصائص السابقة. وكانت معدلات إضافة الكمبوست هي صفر، 2,5 ، 5,0 ، 7,5 طن/ف ، ومعدلات 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 زيادة واضحة في تيسر عناصر النتروجين، الفسفور والبوتاسيوم في موسمي النمو. زادت قيم العناصر الصغرى بالتربة (الحديد، الزنك، المنجنيز والنحاس) مع كل المعاملات المستخدمة في الموسمين. أدت كل المعاملات إلى حدوث زيادة في تركيز وامتصاص العناصر الكبرى (النتروجين والفوسفور والبوتاسيوم) والعناصر الصغرى (الحديد، الزنك، المنجنيز والنحاس) في حبوب وقش الذرة والشعير في كلا الموسمين. حدثت استجابة معنوية في المحصول ومكوناته لكل من الذرة والشعير مع كل المعاملات، وقد نتجت اعلي قيمة في المحصول ومكوناته في الذرة والشعير بإضافة 7,5 طن كمبوست للفدان في مول بعمق 30 سم مع 100 % من الجرعة الموصي بها تسميد نتروجيني حيث أعطت تحسنا واضحا في تيسير المغذيات الكبرى والصغرى للنبات، كما سجلت أعلي زيادة في محصول حبوب الذرة 3,3787 طن/ فدان ومحصول حبوب وقش الشعير 2,9327 ، 4,2013 طن/ فدان علي التوالي ، كما لوحظ أن تجمع العناصر الصغرى بالنباتات يكون في نطاق الحدود المسموح بها ولم يؤثر علي نقص إنتاجية المحصول.