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INFLUENCE OF TILLAGE DEPTH AND ORGANIC RESUIDE PLACEMENT ON CALCAREOUS SOIL PRODUCTIVITY UNDER IRRIGATION FREQUENCIES WITH HIGH SALINE WATER.

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A Field experiment was conducted at Ras Suder experimental station of DRC, South Sinai, during 1998/1999-winter season. The aim of this experiment is to study the effect of tillage depth and application method of organic residue on calcareous soil productivity, under different irrigation frequencies with high saline water. The treatments were; two irrigation frequencies (7 VS 14-day interval); two tillage depths (20and 30-40cm depth); three methods of applying organic residue, i.e., (surface, mixed and layer), beside the control (without applying residue). The treatments were arranged in a split split plot design with five replicates.

Wheat production was affected significantly by the imposed treatments. The grain and straw yields of wheat crop increased significantly due to tillage depth; application method of residue and/or irrigation interval. The N, P, K, Fe, Mn and Zn contents of wheat grains and straw were significantly increased due to the studied treatments. The highest yield was obtained by mixing (5 ton/fed.) organic residue and plowing calcareous soil at 30-40cm depth under 7-day irrigation interval. This was actually reflected in increasing usage efficiency values for both water and NPK by wheat plants.

Tillage and/or organic residue under the two studied irrigation periods have affected soil properties. The soil pH, EC, SAR and ESP values as well as the concentrations of soluble Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, HCO^{-}_{3} and $SO^{=}_{4}$ were decreased with different magnitudes in the tillage with organic residue treatments under both irrigation frequencies. The extractable amounts of N, P, K, Fe, Mn and Zn in the studied calcareous soil were positively affected by the imposed treatments.

In conclusion, incorporating organic residues, along with tilled the soil to 30-40cm could be recommended as a best management practice for calcareous soil irrigated with high saline water. Incorporating organic residue may be a feasible means of realizing the yield potential of wheat crop under conditions of calcareous soil and saline irrigation water.

Keywords: tillage depth, organic residue, saline water, calcareous soil, irrigation frequency, wheat plants.

One of the aims of soil tillage is to bring the soil in a physical condition favorable for plant growth i.e. to develop a desirable soil structure for seedbed along with minimize resistance to root penetration especially under calcareous soil conditions. However, in recent years, there has been increasing interest in minimum tillage systems as a mean of reducing crop production coasts and improving soil conditions. As the tillage tools are mechanical devices that are used to apply forces to the soil to cause some desired effects such as pulverization, cutting inversion or movement of the soil (El-Banna *et al.*, 1987). On the other hand, application of crop residue into the production system may be one of the best ways to ensure sustained soil productivity in the semi-arid regions (Nicou and Chopart, 1979 and Unger, 1984). Sustaining calcareous soil productivity depends on maintaining favorable soil physical, nutritional and biological properties that enhance plant growth. In this respect, the use of optimum tillage in combination with organic wastes as crop residue, farm yard manure (FYM), town refuse, poudrette...etc could be utilized for this purpose (Unger, 1984; Wilhelm *et al.*, 1989; Parr *et al.*, 1989 and 1990; Oppong, 1991; Papendic *et al.*, 1991; El-Maghraby *et al.*, 1996; El-Maghraby and Wassif, 1999). Although, introducing such practices in the farming systems is efficient with good quality water and under the rainfed conditions, information among the use of such materials under irrigation intervals with saline water and/or tillage depth is still lacking. Therefore, the aim of the present investigation is to study the role of tillage depth and organic residue placement on calcareous soil properties under different irrigation frequencies with high saline water. Also to what extent did such practices contribute to sustained productivity of wheat plants grown under such conditions.

MATERIALS AND METHODS

A field experiment was conducted at Ras Sudr experimental station of Desert Research Center (DRC), South Sinai during 1998/1999-winter season. The aim of this experiment is to study the effect of tillage depth and application method of organic residues under different irrigation frequencies with high saline water. The soil of the experimental site is characterized by *Typic Torripsamments, mixed, Hyperthermic* as well as highly calcareous soil (51.23% $CaCO_3$) highly saline (EC of 14.36dS m^{-1}) and sandy loam in texture. The most dominant cation is sodium while chloride is the most dominant anion (Table, 1a). The experiment was carried out in a split split plot design with five replicates. Two irrigation intervals namely: 7 vs 14 day interval (denoted as W_1 and W_2) were used as the main treatments. Two tilled depths, *i.e.,* (20 and 30-40cm depth, denoted as T_1 and T_2) were occupied the sub plots. The T_1 was done as one pass by a rotary tiller to cut, loosen and mix the soil up to 20-cm depth. While the T_2 was carried out as three passes with a chisel plow fitted with five curved shanks 60 cm apart and at a 30-40-cm depth. Three methods of applying organic residues (at the rates of 5ton fed^{-1}), namely: as a surface mulch (OR_1); or incorporating with the upper 20cm depth (OR_2); or in a carpet like layer at 20cm depth (OR_3), beside the control (without applying organic residues) were also applied as sub sub treatments. The used organic residue is the wastes of plant residue, &animal manures in a compost form after being fermented for obtaining biogas in the experimental station of DRC at Ras Sudr (Table1b). The size of each plot was 5 x 7m and was surrounded by buffer strips 1.5 m wide to minimize water seepage from one plot to another.

Wheat grains (*Triticum astivum,* Sakha 8) of 60kg/fed was the test crop, sown on15th November1998. Irrigation treatments were introduced utilizing the highly saline well water of 7300-ppm, (Table, 1c). The total seasonal amount of applied water reached 2130 and 1760 m^3/fed for the two studied irrigation treatments, respectively.

TABLE(1a).Physical and chemical analysis of the experimental site at Ras Sudr.

Physical properties.										
Particle size Distribution (%)				Texture Class	Field capacity (%)	Wilting point (%)	Available Water (%)	$CaCO_3$ (%)	Organic Matter (%)
C. sand	F. Sand	Silt	Clay						
39.43	39.7	8.57	12.3	Sandy Loam	19.2	10.8	8.4	51.23	0.22

Chemical properties										
pH	EC (dS/m)	ESP (%)	Cations (me/L)				Anions (me/L)		
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	CL^{-}	$SO4^{=}$
8.2	14.36	13.5	48.2	34.78	58.87	1.82	2.74	104.21	36.31

Extractable (Available) elements (ppm)						
N	P	K	Fe	Mn	Zn	Cu
11.68	4.88	30.6	2.2	0.83	0.65	0.34

TABLE (1b). Composition of the used organic residue (Biogas).

PH	Moisture (%)	O.M (%)	Total macronutrient (%)			Total micronutrient (mg/kg)			
			N	P	K	Fe	Mn	Zn	Cu
6.63	13.48	34.6	2.26	0.92	1.22	220	104	75	24

TABLE (1c). Chemical analysis of the saline well water used for irrigation.

EC (dS/m)	Cations (me/L)				Anions (me/L)				SAR
	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO_3^{=}$	HCO_3^{-}	CL^{-}	$SO4^{=}$	
11.4	38.82	27.6	46.1	1.26	-	4.2	64.8	45.6	7.99

All plots were fertilized with superphosphate (15.5%) at the rate of 22.5 kg P_2O_5/fed before planting during the tillage practices; ammonium nitrate (33.5%) at the rate of 67 kg N/fed. applied at three 15day intervals from planting, along with potassium sulphate (48%) at the rate of 48 kg K_2O/fed. Plants were harvested at maturity and the biological yield (grains and straw) was recorded and compared statistically (Snedecor and Cochran, 1980). Also, wheat contents of N, P, K, Fe, Mn and Zn were determined according to Chapman and Pratt (1961). Then, water and NPK use efficiencies were calculated. After harvesting, surface soil samples (0-30 cm depth) were taken for the determination of soil chemical properties of the studied soil according to Olsen *et al.* (1954); Richards (1954); Watanabe and Olsen (1965); Lindsay and Norvell (1978); Page *et al.* (1982) and Black (1983).

RESULTS AND DISCUSSION

Effect of the Experimental Treatments on the Yield of Wheat Plants

The effect of soil tillage, organic residue placement and irrigation frequency on the yield of wheat crop is shown in table, (2) and fig.(1). The application of organic residue supported to tilled calcareous soil led to significant increases in the yield of both grains and straw. The rate of increment depended up on tillage depth and/ or the application method of organic residue. It reached 15.78 and 18.39% for grains and straw yields, respectively due to T_2 if compared with T_1,. while the respective increment amounted 34.78; 81.2 and 52.2% (for grain yields) referring to OR_1, OR_2 and OR_3, respectively. The superior performance of tilled plots with incorporated organic residue (T_2+OR_2) with respect to grain yield and /or total dry matter production, might be the result of improving soil physicochemical properties which affecting plant growth namely; soil structure, available water and soil salinity (Tate, 1987), thereby providing favorable environmental conditions with low salt and moisture stress to enable better growth for wheat plants. However, W_2 irrigation interval reduces the grain and straw yields by 22.6 and 25.31% regardless of either tillage or organic residue treatments. This may be rendered to prolonged moisture stress as a result of long intervals between irrigation (El-Kommos and Nour El-Din, 1990). Also, long irrigation intervals cause increase in respiration (loss of water) and detriment of photosynthesis upon increasing water stress (Ghazy *et al.*, 1987).

Generally, the efficiency of the imposed treatments on increasing the yields of wheat crop, could be arranged in the following order: $T_2OR_2>T_1OR_2>T_2OR_3>T_1OR_3>T_2OR_1>T_1OR_1>T_2>T_1$. This was true under the two studied irrigation treatments.

Water and NPK use efficiencies were significantly affected by the imposed treatments. Data in table (2) indicated that the highest values for both water and NPK-use efficiencies were obtained with incorporating organic residue (OR_2) in calcareous soil tilled to 30-40cm under 7-day irrigation interval, which means that, this combined treatment is superior for maintaining favorable conditions for plant growth. The high values of W_{UE}, N_{UE}, P_{UE} and K_{UE} under the T_2 tilled plots with incorporation (OR_2) was perhaps due to the improvement of soil physical, chemical and biological conditions resulting from residue decomposition (Unger,1984 and Tate, 1987). Or due to the altered of carbon/ nitrogen ratio of the soil (Unger, 1984), thus will induce rapid growth and development of wheat crop, hence utilizing the available water and NPK more efficiently.

Effect of Treatments on Nutrients Content

Data illustrated in figs. (2 and 3) exhibited that the concentrations of N, P, K, Fe, Mn and Zn in both grains and straw of wheat plants were significantly increased due to tillage, irrigation frequency and/or organic residue treatments. For example, the increase in N concentrations of grains was proportional to the application method of organic residue, which amounted to 15.23, 24.91 and 11.13% over the control for the mean values of OR_1, OR_2 and OR_3, regardless of tillage and irrigation treatments. The respective increment for P reached 15.33, 29.93 and 25.55%, respectively. While T_2 (tillage treatment) resulted in 6.28 and 9.42% increases over the T_1 for N and P grain contents respectively, regardless of organic residue & irrigation treatments. However, W_2 (irrigation treatment), increased the P grain content by 9.42% over the W_1 regardless of organic residue and tillage treatments. Also, similar trends were obtained for N and P uptakes by wheat plants (Table 3), where they increased significantly depended up on the tilled depth, the application method of organic residue and /or irrigation interval. The same similar trends were also obtained for K, Fe, Mn and Zn contents either in grains or in straw. It is also obvious that the concentrations of such nutrients were relatively higher under the long irrigation interval (W_2) due to the adverse effect on the yield (Table 2). The positive effect of studied treatments on increasing the contents of such nutrients is a true reflection of improving some physical and chemical properties of the calcareous soil under investigation (Tate, 1987) or due to the role of organic residue on the supply of nutrients, where the decomposition of such material induced the slow release of nutrients in an available form to make it accessible to plants for better growth and nutrients uptake (El-Maghraby and Wassif, 1999). Also due to the relative beneficial effect of such materials on lowering soil pH values (Table 5), and consequently increased the availability of P, Fe, Mn and Zn beside the higher initial content of such nutrients in the applied organic residues (Table 1b). In most cases, the higher nutrients content of wheat plants was obtained with the combined treatment of (W_1.T_2.OR_2).

TABLE (2). Yield of wheat plants as affected by the experimental treatments.

Treatments			Yield (Ton/fed).			WUE kg grains /m³	Fertilizer use Efficiency kg(grains)/ fertilizer unit		
Irrigation interval	Tillage	Appl. method.	Grain	Straw	Total		N	P	K
W₁	T₁	Control	0.963	0.878	1.841	0.452	14.366	42.78	20.052
		OR₁	1.834	1.164	2.998	0.861	27.369	81.50	38.203
		OR₂	2.334	1.760	4.094	1.096	34.832	103.72	48.620
		OR₃	2.023	1.484	3.507	0.950	30.187	89.89	42.135
	T₂	Control	1.609	1.341	2.950	0.755	24.011	71.50	33.516
		OR₁	1.890	1.389	3.279	0.887	28.209	84.00	39.375
		OR₂	2.584	1.915	4.499	1.213	38.563	114.83	53.828
		OR₃	2.123	1.705	3.828	0.996	31.679	94.33	44.219
W₂	T₁	Control	0.890	0.659	1.549	0.509	13.284	39.56	18.542
		OR₁	1.291	0.932	2.223	0.738	19.272	57.39	26.901
		OR₂	1.748	1.290	3.038	0.999	26.082	77.67	36.406
		OR₃	1.545	1.142	2.687	0.883	23.060	68.67	32.188
	T₂	Control	1.334	0.737	2.071	0.762	19.907	59.28	27.786
		OR₁	1.448	1.131	2.579	0.827	21.604	64.33	30.156
		OR₂	2.024	1.548	3.572	1.156	30.205	89.94	42.161
		OR₃	1.609	1.252	2.861	0.919	24.011	71.50	33.516

Factor	Statistical analysis LSD at 5% for						
	Grain	Straw	Total	WUE	NUE	PUE	KUE
A- Irrigation interval	0.153	0.114	0.329	0.064	2.130	5.213	4.416
B- Tillage	0.183	0.140	0.354	0.043	2.044	6.254	4.109
C- Application on method.	0.108	0.069	0.263	0.087	2.085	7.244	4.978
A x B	0.260	0.102	0.390	0.037	1.192	4.891	3.587
A x C	0.153	0.081	0.229	0.051	1.098	5.012	4.064
B x C.	0.215	0.108	0.323	0.028	1.077	4.334	3.013
A x B x C	0.155	0.197	0.233	0.033	1.103	3.796	2.089

W_1 = 7 days irrigation period.
W_2 = 14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.
WUE= water use efficiency.
NUE = nitrogen use efficiency.
PUE = phosphorus use efficiency.
KUE = potassium use efficiency.

TABLE (3).Nutrients uptake of Wheat plants as affected by the experimental treatments

Treatments			Grain						Straw					
			Kg/fed.			g/fed.			Kg/fed.			g/fed.		
Irrigation interval	Tillage	Appli. method.	N	P	K	Fe	Mn	Zn	N	P	K	Fe	Mn	Zn
W_1	T_1	Control	15.567	3.398	4.166	90.5	19.5	22.5	4.696	0.966	0.949	53.64	5.128	10.68
		OR_1	28.240	6.418	7.518	205.4	41.8	46.6	7.607	1.629	1.529	84.73	7.378	15.37
		OR_2	39.207	9.802	11.202	322.1	57.2	66.5	12.547	2.956	2.707	157.83	12.517	26.08
		OR_3	29.124	7.888	8.293	248.8	42.9	45.3	9.072	2.316	1.951	118.67	8.299	17.29
	T_2	Control	23.810	5.792	6.757	175.4	34.9	38.9	7.797	1.787	1.671	95.02	8.101	16.88
		OR_1	30.051	7.749	8.694	240.0	47.8	49.9	9.376	2.278	2.048	114.69	9.155	19.07
		OR_2	44.182	11.369	13.177	377.2	70.0	75.2	13.902	3.371	3.131	181.77	13.912	28.98
		OR_3	34.385	8.490	8.702	278.0	48.4	50.3	11.726	2.729	2.241	145.21	10.088	21.02
W_2	T_1	Control	13.528	3.026	3.471	100.6	19.8	22.3	3.829	0.807	0.742	48.43	4.114	8.57
		OR_1	20.402	4.907	5.423	153.7	33.6	33.6	6.248	1.416	1.254	72.07	6.047	12.60
		OR_2	28.310	7.689	7.864	242.9	54.7	49.6	8.869	2.270	1.860	116.54	9.143	19.05
		OR_3	23.793	7.107	6.644	217.8	34.5	37.4	7.463	2.101	1.574	104.64	6.896	14.37
	T_2	Control	20.406	4.802	5.869	137.4	30.8	35.3	4.787	1.062	1.040	49.36	4.876	10.16
		OR_1	21.423	6.369	6.659	176.6	37.5	39.2	7.103	1.990	1.667	89.66	7.648	15.93
		OR_2	29.547	9.714	10.321	277.3	52.6	62.3	9.596	2.973	2.531	137.89	11.904	24.80
		OR_3	23.166	7.561	7.239	207.5	38.8	42.5	7.654	2.354	1.806	105.00	8.252	17.19

Statistical analysis												
Factor	LSD at 5% level for											
	grains						straw					
	N	P	K	Fe	Mn	Zn	N	P	K	Fe	Mn	Zn
A- Irri.inter	7.006	1.423	0.612	10.439	6.288	3.853	1.709	0.511	0.124	7.412	0.350	0.908
B- Tillage	4.059	1.351	0.481	6.048	3.643	2.232	0.990	0.345	0.113	4.294	0.203	0.876
C- Appli. method.	3.547	0.628	0.372	5.285	3.183	1.951	0.865	0.344	0.118	3.753	0.177	0.744
A x B	3.278	0.536	0.413	4.884	2.942	1.803	0.800	0.287	0.091	3.468	0.164	0.692
A x C	4.113	0.415	0.227	6.128	3.691	2.262	1.004	0.403	0.064	4.352	0.206	0.672
B x C.	3.271	0.522	0.316	4.874	2.936	1.799	0.798	0.207	0.035	3.461	0.164	0.460
A x B x C	2.008	0.323	0.419	2.992	1.802	1.104	0.490	0.310	0.213	2.124	0.100	0.844

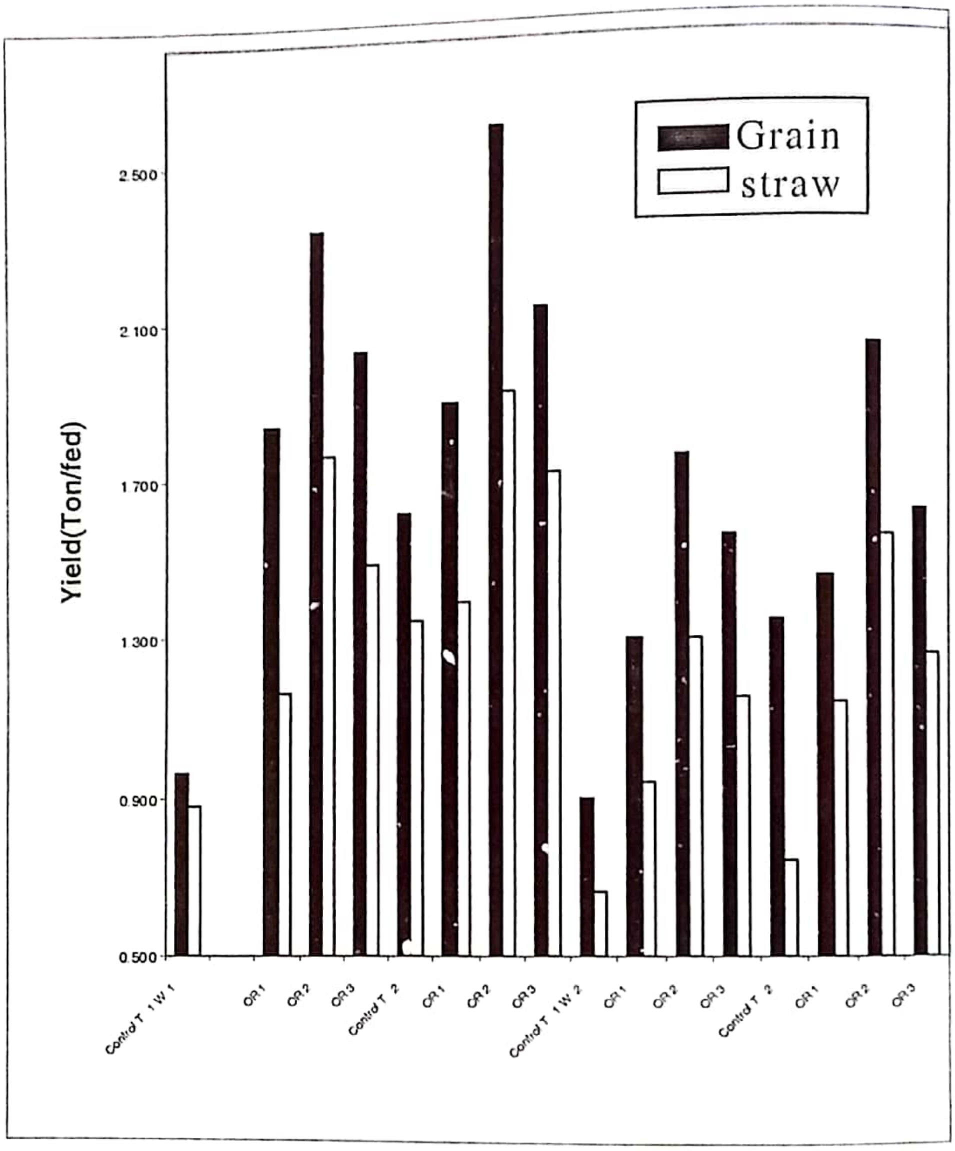

Fig. (1). Yield of wheat plants as affected by the experimental treatments.

W_1 = 7 days irrigation period.
W_2 =14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.

Effect of Treatments on Soil Chemical Properties

With respect to results in table (4), it could be concluded that, the soil pH, EC SAR and ESP values as well as the concentrations of soluble Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Cl^{-}, HCO^{-}_3 and $SO^{=}_4$ were greatly increased with different magnitudes in the untreated plots. This was true under the two experimental irrigation frequencies, however, such values were higher under long irrigation interval. This was true because the soil was subjected to evaporation for long periods, therefore, salt accumulation increased. Opposite trends were obtained in the tilled plots treated with organic residue either as surface mulch; incorporating it with soil or as a carpet like layer, for the soil pH, EC SAR and ESP values as well as the concentrations of soluble (Ca^{2+}, Mg^{2+}), Na^+, K^+, Cl^-, HCO^-_3, and $SO^=_4$ The values of such parameters were greatly decreased in accordance to the tilled depth; method of applying organic residue and/or irrigation intervals. The efficiency of organic residue on reducing the values of such parameters may be attributed to the formation of the organic and inorganic acids during the decomposition of such material, which contribute to reduce the soil pH values. Also due to increasing the ability of the soil to hold water, consequently, more soluble salts became prone to escape downward by the following irrigation, to deeper soil layers. This reflected in decreasing EC and ESP values. On the other hand, reducing the surface evaporation from the tilled soil with surface residue placement (El-Maghraby and Wassif, 1999) may have a role on increasing the infiltration rate of the studied calcareous soil and consequently reduce the soil EC and ESP values. The highly reduction in Na^+ ions as compared to that of Ca^{2+} + Mg^{2+} may be the result of reducing SAR values in the organic residue treated plots. It is also evident from the data that either the surface or the incorporating organic residue is more effective treatments in reducing the concentrations of soluble ions and soil EC values compared to the other method of application.

TABELE (4).Chemical properties of the investigated calcareous soil as affected by the experimental treatments. (mean value of five replicates).

Treatments			pH	ESP (%)	EC (dS/m)	Soluble cations (me/l)			Soluble anions (me/l)				SAR
Irrigation interval	Tillage	Appl. Method				(Ca^{2+} mg^{2+})	Na^+	K^+	Cl^-	$CO_3^=$	HCO_3^-	$SO_4^=$	
W_1	T_1	Control	8.42	26.52	16.20	86.94	71.52	3.14	125.02	-	5.02	32.06	10.85
		OR_1	7.74	11.56	7.48	40.72	33.37	0.94	57.71	-	2.29	14.86	7.40
		OR_2	7.62	7.69	6.21	33.66	27.58	0.78	47.74	-	1.92	12.27	6.73
		OR_3	7.44	6.34	8.34	45.18	36.92	1.04	63.87	-	2.56	16.43	7.77
	T_2	Control	7.60	21.88	7.25	39.84	32.51	0.92	56.21	-	2.24	14.44	7.29
		OR_1	7.33	8.06	5.11	27.81	22.81	0.61	39.14	-	1.54	10.12	6.12
		OR_2	7.23	7.58	4.56	25.02	20.50	0.54	35.38	-	1.38	9.08	5.79
		OR_3	7.40	6.11	6.19	32.84	28.62	0.82	47.82	-	1.96	12.22	7.07
W_2	T_1	Control	7.72	28.11	17.20	92.32	75.92	3.32	132.62	-	5.42	34.02	11.18
		OR_1	7.50	13.05	7.15	38.62	32.50	0.94	55.42	-	2.32	14.42	7.40
		OR_2	7.35	9.44	6.46	34.85	29.32	0.82	50.02	-	2.02	13.08	7.01
		OR_3	7.51	8.57	8.84	47.21	39.48	1.22	66.82	-	2.72	18.62	8.12
	T_2	Control	7.64	24.37	9.68	52.05	43.18	1.38	73.48	-	3.02	20.48	8.47
		OR_1	7.45	12.11	5.48	29.54	24.66	0.78	41.62	-	1.68	11.82	6.42
		OR_2	7.44	8.33	5.17	27.82	22.92	0.92	40.02	-	1.72	10.44	6.14
		OR_3	7.61	7.39	7.08	37.88	31.36	1.38	54.22	-	2.25	14.21	6.92

W_1 = 7 days irrigation period. W_2 = 14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.

TABLE (5). Nutrients status of the soil after harvesting as affected by the imposed treatments (mean values of 5 replicates).

Treatments			Total N (ppm)	Available (ppm)				
Irrigation interval	Tillage	Appl. method.		P	K	Fe	Mn	Zn
W1	T1	Control	612	4.2	29.18	2.08	2.39	1.09
		OR1	935	5.8	44.43	2.68	3.91	2.13
		OR2	808	7.2	52.17	3.63	4.86	2.18
		OR3	952	5.7	49.08	5.32	4.60	2.25
	T2	Control	766	6.7	36.27	3.03	2.86	1.79
		OR1	876	9.8	48.21	4.36	5.13	2.09
		OR2	978	11.4	58.39	5.42	6.40	2.19
		OR3	1071	7.9	51.87	5.43	7.12	2.29
W2	T1	Control	901	6.4	32.47	3.92	3.71	2.11
		OR1	1097	7.7	46.13	4.47	4.63	2.18
		OR2	1309	8.4	58.92	5.89	6.57	2.34
		OR3	1360	8.2	53.33	6.83	7.40	2.37
	T2	Control	1012	8.5	36.85	4.69	6.21	2.14
		OR1	1275	9.4	46.75	6.92	7.49	2.16
		OR2	1241	10.2	60.33	6.43	8.71	2.18
		OR3	1165	8.4	54.02	7.49	10.33	2.19

W_1 = 7 days irrigation period. W_2 = 14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.

Data in table (5) indicated that, total N as well as the availability of P, K, Fe, Mn and Zn were affected favorably depending up on the tilled depth and method of applying organic residue at any of the used irrigation intervals. The addition of OR_1, OR_2 and OR_3 increased soil nutrients availability, however, the rate of increase was differed from one element to another. The highest values of such nutrients were found, in most cases, with OR_3 treatment in which the organic residue was applied as a carpet like layer at 20cm depth. The increases over the control due to OR_3 regardless of tillage depth and irrigation frequency, reached 38.21, 16.89, 54.56, 82.69, 94.21 and 27.51% for N, P, K, Fe, Mn and Zn, respectively. This may be referred to the higher initial content of such nutrients in the used organic residue (Table, 1b), beside its effect on lowering soil pH values through the biodegradation of such materials by soil microorganisms (Dahdoh and El Hassanin, 1994). A very similar trend with lesser magnitudes was found in the application of organic residue under W_2 irrigation treatment. On the other hand the T_2 tillage depth increased the availability of N, P, K, Fe, Mn and Zn by 5.13, 34.75, 7.38, 25.62, 42.46 and 27.29 respectively, regardless of organic residue and irrigation frequency. This may be rendered to the favorable effect of tillage on enhancing some soil physical and chemical properties (Unger,1984). Generally, the best treatment on increasing the availability of the studied nutrients (in most cases, after harvesting wheat crop) was the combined treatment of (W_1•T_2•OR_3).

From the aforementioned results it could be concluded that, incorporating of organic residue may be a feasible means of realizing the yield potential of wheat crop under conditions of calcareous soil and saline irrigation water. Mixing 5 ton/fed organic residue along with tilled calcareous soil to a depth of 30-40cm induced favorable effects on the productivity parameters of calcareous soil under higher and lower irrigation frequencies with high saline irrigation water.

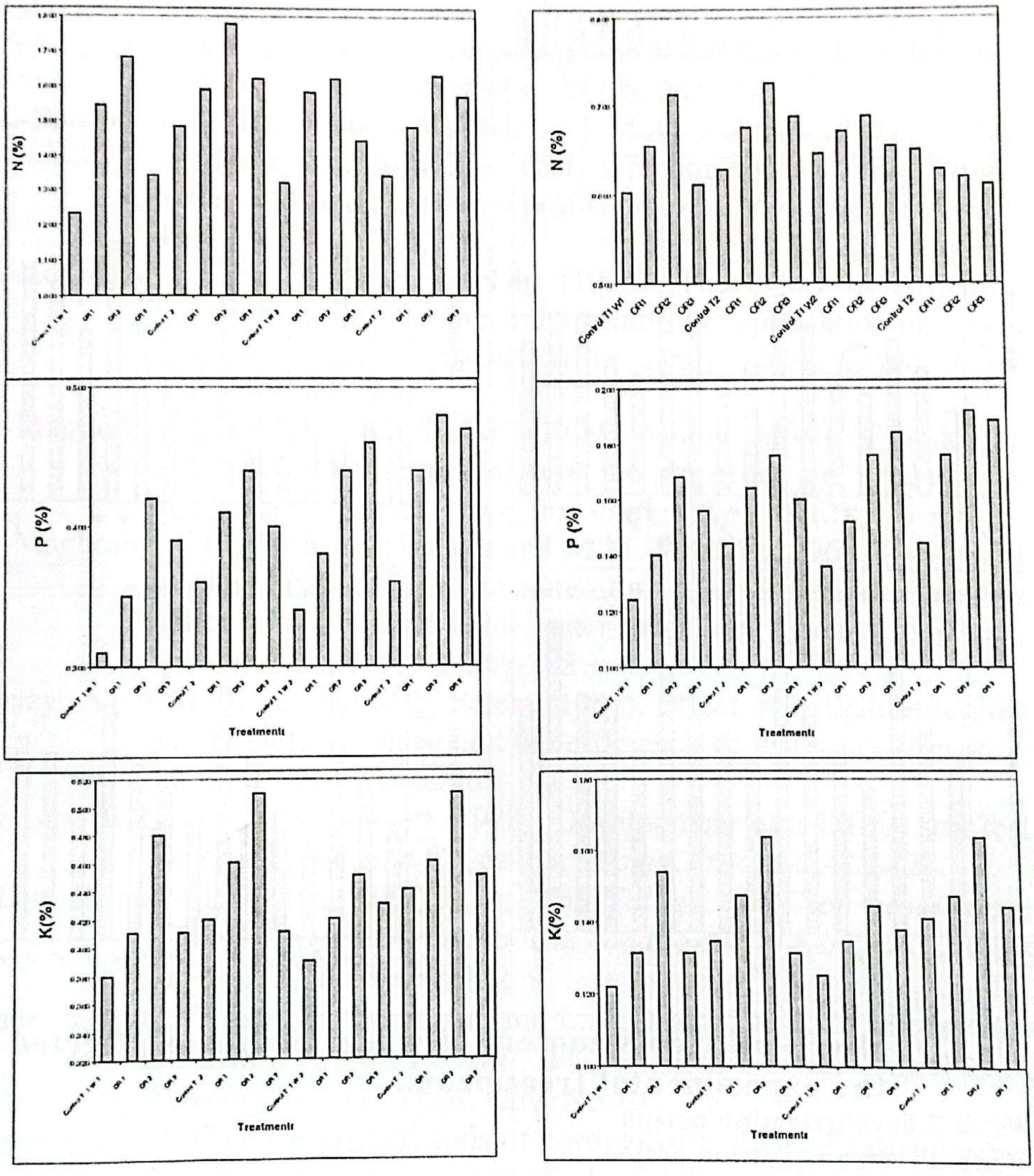

Fig. (2). Macro-nutrients content of wheat plants as affected by the experimental treatments.

W_1 = 7 days irrigation period.
W_2 = 14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.

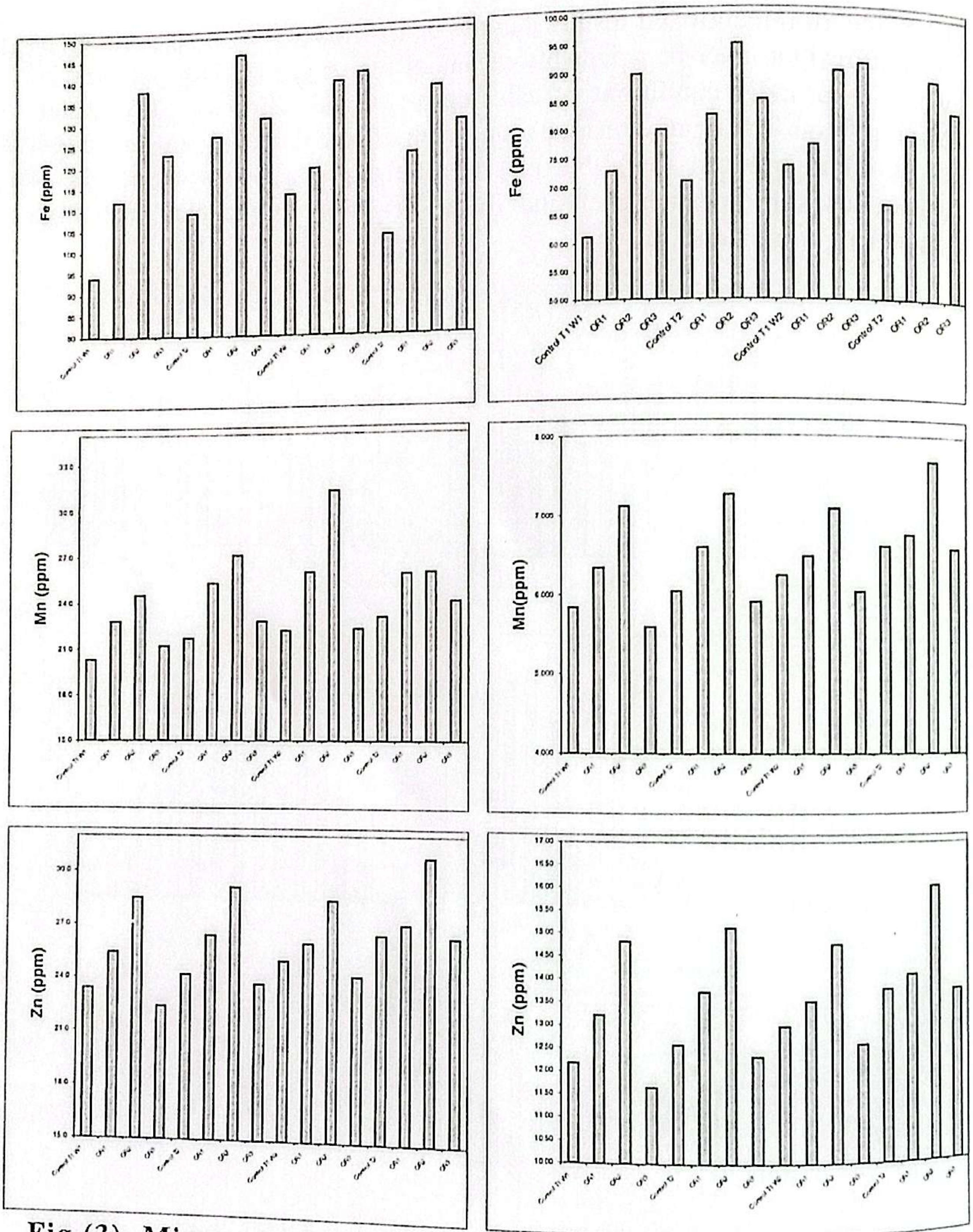

Fig.(3). Micro-nutrients content of wheat plants as affected by the experimental treatments.

W_1 = 7 days irrigation period.
W_2 = 14 days irrigation period.
OR_1 = surface mulch.
OR_2 = surface incorporated with the upper 20 cm depth.
OR_3 = carpet like layer at 20 cm depth.

REFERENCES

Black, C.A. (1983). In "*Methods of soil analysis*". Part (1 and 2). Soil Sci. Soc. and Am.Jnc. Pub., Madison, Wisc.,USA.

Chapman, H.D. and P.F. Pratt (1961). In "*Methods of analysis for soils, plants and waters*". University of California, Div. Agric. Sci.

Dahdoh, S.A. and A.S. El-Hassanin (1994). Combined effects of organic source, irrigation water salinity and moisture level on the growth and mineral composition of barley grown on calcareous soil. *Desert Inst. Bull. Egypt*, 44 (2): 247-264.

EL-Banna, B.B.; H.N. Abdel-Mageed and M.A. Helmy (1987). Tillage machinery and timeliness costs affecting soil structure, winter barley and sugar beet crop profits. *Misr J. Ag. Eng.*, 4(4): 419-434.

El-Kommos, F. and Y. Nour El- Din (1990). The effect of irrigation frequency under varying soil amendments application on wheat and broad beans production in sandy soils. *Egypt. J.Soil Sci.*,30(3): 403-414.

El-Maghraby, S.E. and M.M. Wassif (1999). Mutual effect of mulching materials and biofertilization on the properties and productivity of a calcareous soil. *Desert Inst. Bull. Egypt,* 49 (2): 477-497.

El-Maghraby, S.E.; Farh, A. Hashem and M.M. Wassif (1996). The use of sulphur and organic manure for controlling soil salinity pollution under high saline water irrigation. *Egypt. J. Soil Sci., Special Issue,* 36(1-4): 269-288.

Ghazy, A.; A.M. Selim and M.Z. Salem (1987). Effect of irrigation regime on the yield of wheat and the efficiency of water use. *Egypt. J. Soil Sci.,* 27(3): 387-396.

Lindsay, W.L. and W.A. Norvell (1978). Development of a DTPA soil test for Zn, Fe, Mn, and Cu. *Soil Sci. Amer.Proc.*,42: 421-428.

Nicou, R. and J.L. Chopart (1979). In "*Soil Tillage and Crop production: Water management methods in sandy soils of Senegal*". Series No.2 (IITA, Ibadan):248-259.

Olsen, S.R.; C.V.Cole; F.S.Watanabe and L.A. Dean (1954). In "*Estimation of available P in soil by extraction with* $NaHCO_3$.". Washington, D.C. USA, Cire. No 19.

Oppong, J. E.(1991). Desertified soils of north Ghana. *Proc. 2nd African Soil Sci. Soc. Conference on "Soil and Water Management for Sustainable Productivity"*. p 423-432.

Page, A.L.; R.H. Miller and D.R. Keeney (1982). In "*Methods of soil analysis*". No. 9 (Part 2) in the Series Agronomy. Amer. Soc. Agron., Madison, Wis., USA.

Papendic, R.I.; J.F. Parr; S. B. Hornic and R.E. Meyer(1991). Managing crop residue in semiarid regions for sustainable crop and livestock production. *Proc. 2nd African Soil Sci. Soc. Conference on "Soil and Water Management for Sustainable productivity"*. p433-448.

Parr, J.F.; B.A. Stewart; S.B. Hornick and R.P. Sing (1990). Improving the sustainability of dry land farming systems: A global perspective. *Advances in Soil Sci.*, 13:1-8.

Parr, J.F.; R.I. Papendic; S.B. Hornick and D. Colacicco (1989). Use of organic amendments for increasing the productivity of arid lands. *Arid Soil Research and Rehabilitation*, 3:149-170.

Richards, L.A. (1954). In "*Diagnosis and improvement of saline and alkali soils*". U.S.D.A. handbook No. 60.

Snedecor, G.W. and G.W. Cochran (1980). In "*Statistical Methods*". The Iowa State Univ. Press, Ames, Iowa, U.S.A. 584 pp.

Tate, R.L. (1987). In "*Soil organic matter: Biological and ecological effects*". John Wiley and Sons, New York. p. 219-291.

Unger, P.W. (1984). Tillage and residue effects on wheat, sorghum and sunflower grown in rotation. *Soil Sci. Soc. Am. J.*, 48: 885-891.

Watananbe, F.S. and S.R. Olsen (1965). Test of ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts from soil. *Soil Sci. Am. Proc.*, 29:677-678.

Wilhelm, W.; W.H. Bouzerzour and J.F. Power (1989). Soil disturbance and residue management effects on winter wheat growth and yield. *Agron. J.*, 8: 581-588.

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تأثير عمق الحرث وطرق إضافة المخلفات العضوية على خواص وإنتاجية الأراضي الجيرية تحت فترات الري بمياه عـــالية الـــملـــوحــــة

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أقيمت تجربة حقلية بمحطة بحوث رأس سدر خلال الموسم الشتوي ١٩٨٨ /١٩٩٩الدراسة تأثير عمق الحرث وطريقة إضافة المخلفات العضوية على خواص وإنتاجية الأراضي الجيريـــة تحت فترات الري بمياه عـــالية الـــملـــوحـــة (٧٣٠٠جزء في المليون) واثر ذلك على خـــواص الأراضي وإنتاجيتها من القمح.

وكانت معاملات الدراسة كالتالي :

(أ) معاملات الري (الري كل٧ أيام و الري كل ١٤يوم).

(ب)معاملات الحرث (الحرث على عمق ٢٠ سم والحرث على عمق من ٣٠ـــ٤٠ سم).

(ج)ثلاثة طرق لإضافة مخلفات المزرعة المكمورة(البيوجاز) بمعدل ٥ طن/فدان إما على السطح أو خلطا بالطبقة السطحية أو على شكل طبقه على عمق ٢٠سم من سطح التربة.

ولقد أشارت النتائج إلى :

١ــ حدوث زيادة معنوية في إنتاجية حبوب وقش القمح نتيجة إضافة المخلفات العضوية مقارنة بالكنترول وقد تفاوتت معدلات هذه الزيادة تبعا لطريقة الإضافة وعمق الحـــرث وكـــذلك الفترة بين الريات. حيث أدى الري كل أسبوع والحرث حتى عمق ٣٠-٤٠سم إلى أعلى إنتاجية لمحصول القش والحبوب.

٢ــ زيادة قيم كفاءة استخدام نباتات القمح للمياه والأسمدة - بالإضافة إلى زيادة محتوى الحبوب والقش من عناصر النيتروجين ، الفوسفور ، البوتاسيوم ، الحديد ، المنجنيز ، الزنك نتيجة إضافة المخلفات العضوية وقد تفاوتت معدلات هذه الزيادة تبعا لطريقة الإضـــافة وعمـــق الحرث وكذلك الفترة بين الريات.

٣ - انخفاض قيم pH ، EC ، نسبة الصوديوم المدمص ونسبة الصـــوديوم المتبـــادل ، وكـــذلك تركيزات الصوديوم ، المغنسيوم ، الكالســـيوم ، الكبريتـــات ، الكربونـــات ، الكلوريـــد ، البوتاسيوم للتربة المعاملة بالمخلفات العضوية.

٤ــ زيادة تيسر عناصر النيتروجين ، الفوسفور ، البوتاسيوم ، الحديد ، المنجنيز ، الزنك بالتربة المعاملة بالمخلفات العضوية وقد تفاوت هذا التأثير باختلاف طريقة الإضافة وعمق الحرث وكذلك الفترة بين الريات . حيث كانت أعلى القيم المتحصل عليها عنـــد الـــري أســـبوعيا بالتربة المحروثة حتى عمق ٣٠-٤٠سم.

وعموما فان أفضل المعاملات التىأدت إلى تحسين خواص الأراضي الجيرية وبالتـــالي تحســـين إنتاجيتها من القمح إضافة ٥ طن للفدان مخلفات عضوية(خلطا) مع حرث الأرض حتى عمق من ٣٠-٤٠ سم والرى كل ٧أيام.