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STUDIES ON SOILS OF TOSHKA REGION
1- STATUS OF SOME NUTRIENTS IN VIRGIN SOILS OF TOSHKA REGION

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ABSTRACT: *Fifteen surface soil samples representing the different mapping units, were collected of virgin soils of Toshka area, bounded by longitudes 30° 30` and 32° 00` east and Latitudes 22° 22` and 23° 26` north. Their physicochemical characteristics were determined using the standard procedures.*

In general, these soils are characterized by medium texture and their salinity widely varied between slight saline to extremely saline. More or less, these soils are calcareous in nature with mildly alkaline soil pH, poor in N,P and K contents. Moreover, the soluble cations and anions contents showed general distribution pattern of $Na^{+} > Ca^{++} > Mg^{++} > K^{+}$ and $Cl^{-} > SO4^{=} > HCO_3^{=}$, respectively. In addition, the total amounts of the tested micronutrients are found in the order of Fe > Mn > Zn > Cu, while their DTPA-extractable amounts, could be considered adequate-marginal for Fe, marginal for Zn and Low for both Mn and Cu.

Statistically, the fine fractions (clay and/or silt) were significantly correlated with the tested available nutrients, therefrom, the relatively fine charged texture may be the effective soil factor affected nutrients availability.

Whether or no, there are many possible factors controlling the reclamation and cultivation of these virgin soils, of which soil fertility is only one. Thereon, more work and studies need to be expanded.

Key words: Toshka region, Soil properties, Macro & micro, nutrients.

INTRODUCTION

In it's effort to modernize and cope has already of started in one of the national mega projects, i.e. Toshka region, which is bounded by longitudes 30° 30` and 32° 00 east, and latitudes 22° 22` and 23° 26` north (Said, 1962). In these area, work is underway, to extend the Nile water into the heart of the western desert to the far out reaches of the Dakhla and kharga Oases. This bold project would create in effect a new Delta and was described as the national project for the twenty first century (Egypt Land of Opportunity, Ministry of Economy, Dec. 1998).

As a general role, desert lands are sandy in texture, poor in organic matter and available nutrients content (Mitkees et al., $1969_{a,b,c}$; Abdel Latif et al., 1987; Khatab et al., 1999 and Rahmou et al., 2001).

The aim of this work is to make a spot light on the fertility status of soils in the virgin soils of Toshka Region.

MATERIALS AND METHODS

Fifteen surface soil samples (0-30 cm.), were collected, during the 2001 year and their sites are marked in Fig. 1. Each soil sample was a composite of ten random sub-samples. Samples were air dried, ground by wooden pestle to avoid away any contamination and then sieved through a 2 mm nylon sieve. Particle size distribution was determined using the pipette method (Kilmer and Alexander, 1949), using sodium hexametaphosphate as a dispersing agent. Soil pH, in soil paste extract was measured by Beckman glass electrodes pH-meter (Richards, 1954). Calcium carbonate was estimated volumetrically using the Collins Calcimeter and gypsum content was also determined by precipitation with acetone (Richards, 1954).

Organic matter was determined by the modified Walkely and Black method as described by Jackson (1965). Cation exchange capacity was estimated using sodium and ammonium acetate (Richards, 1954). The soil samples were analyzed for both total soluble salts (ECe) and soluble ions in soil paste (Richards 1954), sulfate was calculated by the difference between the sum of cations and anions.

Total soluble nitrogen was determined by the method described by Jackson (1973). The available form of soil phosphorus was estimated by the method described by Olsen et al. (1954). Available postassium was determined flamephotometrically by the ammonium acetate method of Black (1965). The total contents of Fe, Mn, Zn and Cu, in the tested soil samples, were determined by digestion soil with mixture of (HF + $HCLO_4$) acids in a platinum crucible (Jakson, 1973), while their available contents were extracted by DTPA (Lindsay and Norvell, 1978). The total and extractable micronutrients were measured by using the atomic absorption spectrophotometer. The obtained data were statistically analyzed according to Sndecor and Cochran, (1989).

RESULTS AND DISCUSSION

The physico-chemical properties of the studied soils listed in Tables 1,2,3 and 4. The mechanical analysis showed that these soils are, in general, characterized by medium in texture, with a wide range of both coarse sand (3.72 - 66.41) and (Silt + Clay), (11.76 to 82.14) soil. pH value was mildly alkaline and ranged 7.27 - 8.15. Data, also showed that these soils are very poor in organic matter content (0.01 to 0.29%) these negligible amounts of organic matter are mainly due to the dryness and hot climate (Serry et al., 1966 and Moustafa et al., 1988).

As for Calcium carbonate the obtained data revealed that its values widely varied within the studied soil samples, ranged from 1.26 to 26.0%. In general, soil $CaCO_3$ values were more than 9%, therefore, these soils could be considered calcareous in nature, according to the definition of Anter et al. (1973). Moreover,

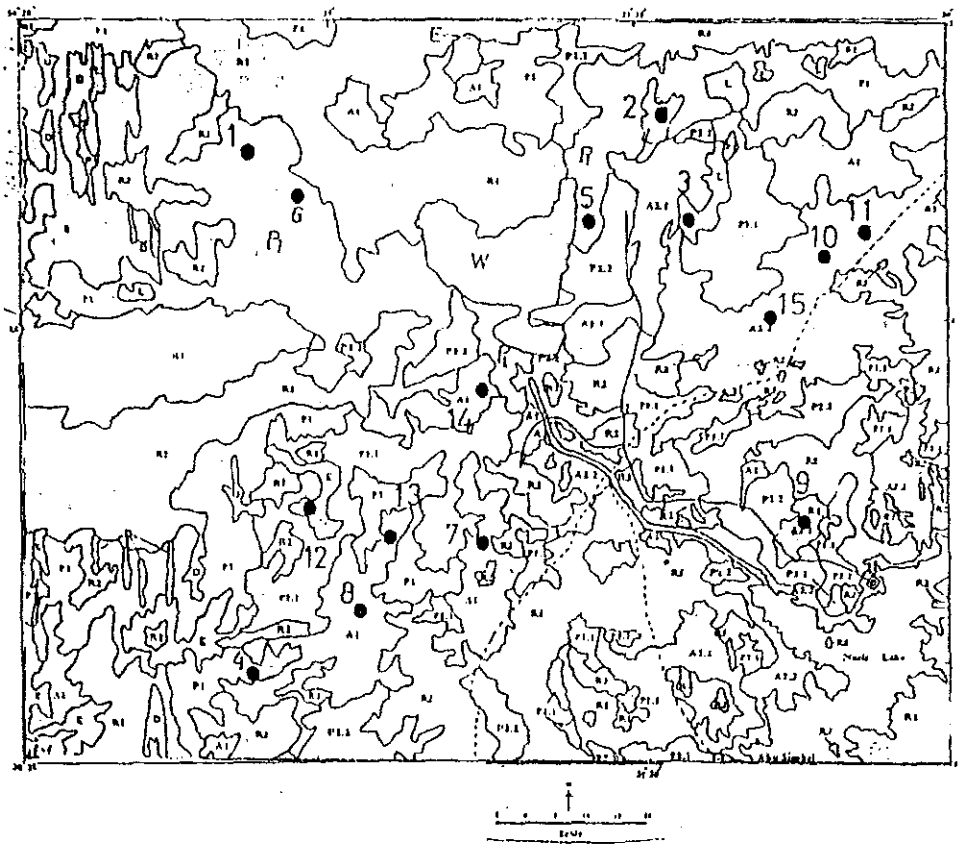

Fig. (1): Locations of the studied soil samples.

- Physiographic soil legend:

- P_1 → Pediplain of soft rock (shale)
- A_1 → Alluvial deposits over soft rock suprolite
- A_2 → Alluvial deposits over hard rock (sandstone) suprolite
- L → Playa
- E → Aeolian plain

- Miscelianeous land types and cover:

- R_1 → Dissected questa.
- R_2 → Rock land.
- D → Barchan sand dunes
- W → Seeped water body with changeable beach line.

the gypsum content was low 10.24-2.52%), except three soil sites had a moderate content of 6.79-7.18%. The values of electric conductivity (ECe) being in the range of 1.26 to 53.52 dS/m , indicate that soil salinity of the studied area fluctuate between slight saline to extermly saline.

Table (1): Partical size distribution, soil pH, organic matter, $CaCO_3$ and gypsum in the studied surface soil samples (0-30 cm.) of Toshka region.

Sample No.	Partical size distribution %					Textural class*	PHin soil past	O.M %	$CaCO_3$ %	Gypsum %
	C. Sand	F. Sand	Silt	Clay	Silt + Clay					
1	4.75	27.50	29.97	37.77	67.74	CL	7.54	0.18	8.67	0.44
2	12.55	28.57	36.95	21.98	71.21	L	7.79	0.29	19.37	6.88
3	3.72	14.12	35.87	46.27	82.14	C	7.84	0.15	13.40	1.57
4	18.45	29.46	22.46	29.63	52.08	SCL	7.48	0.23	14.94	2.52
5	5188	29.37	7.76	10.99	18.73	SL	7.27	0.15	13.08	6.79
6	22.65	26.93	21.56	28.86	50.41	SCL	7.57	0.14	6.26	1.21
7	47.64	25.44	11.74	15.18	26.91	SL	7.89	0.16	15.98	0.31
8	47.88	27.29	10.41	14.42	24.82	SL	7.61	0.07	1.26	0.24
9	47.52	22.75	12.20	17.53	29.73	SL	7.55	0.07	26.00	0.84
10	58.44	28.48	5.74	7.29	13.07	LS	8.15	0.03	9.17	0.25
11	62.82	25.43	4.81	6.94	11.76	LS	7.78	0.02	9.10	0.28
12	66.41	18.89	6.94	7.76	14.69	LS	7.67	0.08	10.68	0.32
13	36.13	20.84	19.23	23.80	43.03	L	7.51	0.11	11.75	7.18
14	52.99	22.03	10.98	14.00	24.98	SCL	7.81	0.02	20.32	0.42
15	56.37	27.77	7.71	8.15	15.86	LS	7.77	0.01	15.54	0.35

* C = Clay , SCL = Sandy clay loam , SL = Sandy loam , S= Sandy, CL= Clay loam, SC = Sandy clay, L= Loam, LS = Loamy sand

Table (2): Chemical composition of the soil saturation extract of surface soils (0-30 cm.) of Toshka soil samples

Sample No.	ECe (dS/m)	Soluble ions (meq/l)								C.E.C. (meq/ 100g soil)
		Cations				Anions				
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{-}	HCO_3^{-}	Cl^{-}	SO_4^{--}	
1	22.56	81.32	33.92	186.25	2.44	-	2.00	176.50	125.44	29.0
2	15.28	31.32	7.49	157.50	2.73	-	2.00	63.00	134.04	18.0
3	13.39	28.95	6.29	126.25	1.27	-	1.70	71.00	90.06	34.0
4	9.75	33.16	9.94	79.38	1.51	-	2.10	39.50	82.38	21.0
5	53.52	186.63	29.56	508.33	1.82	-	1.73	567.66	166.90	7.0
6	13.58	33.42	22.54	107.50	1.63	-	1.70	77.50	85.88	19.0
7	4.42	12.64	3.32	36.85	1.54	-	1.60	13.00	39.77	10.0
8	5.09	31.58	1.92	31.00	0.89	-	1.53	17.00	46.86	12.0
9	17.99	57.63	6.65	140.00	3.55	-	1.70	100.50	105.64	9.0
10	1.26	4.20	1.03	9.20	0.65	-	2.20	3.20	9.69	6.0
11	3.86	22.27	2.36	17.60	1.09	-	1.70	14.10	27.51	4.0
12	9.80	38.16	10.89	70.00	1.84	-	1.70	53.50	65.69	5.0
13	9.40	41.57	8.19	69.65	1.45	-	1.60	57.50	67.77	13.0
14	4.75	21.84	5.78	32.25	1.54	-	1.70	13.50	46.21	9.0
15	1.82	10.00	0.33	11.58	1.14	-	1.80	6.00	15.25	6.0

In general, the soluble cations are found to be in the order of $Na^{+} > Ca^{++} > Mg^{++} > K^{+}$ in the investigated soil samples. In addition, the soluble anions showed general a distribution pattern, soil $Cl > SO_4^{=} > HCO_3^{-}$, while $CO_3^{=}$ was absent, in the representative soil samples. Cation exchange capacity of the soils under consideration was in the range of 4 and 34 meq/100 g soil. The highest value was in sample No. 3 and the lowest one was in sample No. 11. C.E.C. values are generally more related to the fine mechanical fraction (silt + clay) and organic matter contents.

As a general role, the porosity in organic matter, which represents the original reservoir of nitrogen forms, reflected on the available N-contents as shown in Table 4. Thereat, the amount of available nitrogen flucetated between 7.12 to 8.92 ppm. It is assumed that the total levels of several essential minerals, e.g. K. P, Fe, Mn, Zn and Cu in soil are depending mainly upon their bearing minerals, while the available forms are quite another story (Tables, 3 and 4).

Table (3): Total micro-nutrients in surface soil samples (0-30 cm.) of Toshka. region

Sample No.	Micronutrients			
	Fe (%)	Mn (ppm)	Zn (ppm)	Cu (ppm)
1	4.5	568	137	16
2	2.4	250	118	19
3	2.6	391	194	32
4	3.9	554	178	18
5	4.0	423	175	17
6	3.4	516	140	18
7	1.6	450	121	12
8	1.6	172	105	10
9	2.7	305	153	13
10	1.5	212	134	8
11	1.7	345	137	8
12	1.7	227	67	6
13	2.6	302	96	15
14	1.7	379	74	14
15	1.2	277	82	7

Table (4): Available macro and micro nutrients in surface soil samples of Toshka region.

Sample No.	Macronutrients (ppm)			Micronutrients (ppm)			
	N	P	K	Fe	Mn	Zn	Cu
1	12.71	15.60	34.22	15.03	2.00	1.59	1.51
2	17.98	10.66	25.74	8.63	1.22	1.22	1.14
3	18.92	10.00	35.88	10.68	1.92	1.34	1.35
4	16.43	10.88	29.25	16.63	0.58	1.24	1.12
5	13.02	10.60	17.16	17.68	0.79	1.56	1.05
6	16.43	7.50	29.25	13.59	0.99	0.75	1.10
7	10.54	10.66	17.94	3.83	1.31	0.63	0.31
8	10.23	4.50	5.46	2.59	0.47	0.55	0.24
9	11.47	6.00	27.69	1.83	1.06	0.58	0.31
10	9.92	4.50	11.70	3.08	0.65	0.43	0.41
11	13.95	7.00	29.36	3.13	0.89	0.38	0.20
12	15.81	4.00	14.82	8.35	0.85	0.45	0.28
13	17.05	4.50	17.94	3.16	0.72	0.64	0.61
14	7.74	4.00	14.04	4.68	0.66	0.46	0.24
15	7.12	4.00	10.14	4.00	0.40	0.44	0.14

Data in the previous tables, also showed that the values of available P- of these virgin soils, to a depth of 0-30 cm, was relatively low, may be due to the general idea, that the alkaline calcareous in nature of the hot climate area, is much great fixer of phosphorus than another kinds of soil. Unlike phosphorus, potassium was present in a relatively low content in most soils, the available form ranged between 5.46 to 35.88 ppm.

Total Fe, Mn, Zn and Cu in the studied soils samples:

Total Fe-content in these soil samples ranged between 1.2-4.5%. The average concentration of total iron in earth crust is about 5% (Goldschmidt, 1954). The highest and the lowest level of total iron are recorded in samples No. 1 and 15, respectively. In general, the coarse texture soils have the lowest Fe-content.

Total – Mn ranged between 172 to 568. Swaine (1955) reported that the range of Mn in soils of the world is about 2000 to 3000 ppm. In Egypt Ghanem et al. (1971) found that both sandy and calcareous soils contain less amount of total manganese than Nile alluvial soils.

Total – Zn ranged from 67 to 17 ppm. Hassanein (2001) found that total Zn in soil samples of Toshka ranged from 49 to 228 ppm.

Total – Cu ranged from 6-32 ppm, with a mean of 14 ppm. The highest contents were found in soil samples Nos. 10, 11, 12 and 15. The obtained data are in full agreement with those obtained by Hassanein, (2001) on Toshka soils.

Generally, the wide range of total Fe, Mn, Zn and Cu in the tested soil samples can be attributed to the differences in the type and nature of soil materials.

Available Fe, Mn, Zn and Cu in the studied soil samples:

Table (4) showed the DTPA-extractable amounts of the studied micro-nutrients. Data obtained exhibited a wide variation in these micronutrients the mean values of Fe, Mn, Zn and Cu were 7.79, 0.97, 0.82 and 0.67 ppm, respectively. Values of DTPA-Fe ranged between 1.83 and 17.68 ppm, while DTPA Mn was 0.40 - 2.0 ppm. Data also, showed that the DTPA-Zn ranged from 0.38 to 1.39 ppm. Hassan, (1979), reported that available Zn values were about 0.7 and 1.4 ppm in sandy and calcareous soils of Egypt, Respectively. DTPA-Cu in these soil samples varied between 0.14 and 1.51 ppm indicate that the majority of soil samples contained low amounts of DTPA-Cu. Abdel Razik, (1997) reported that available copper extracted by DTPA ranged from 0.17 to 2.0 ppm and from 0.04 to 3.8 ppm in sandy and calcareous soils, respectively. The previous data are in agreement with those obtained by Hassanein (2001) for Toshka soils.

By using the index values of Soltanpour and Schwab, (1977) to interpret the former data, it can be concluded that these soils are belonging to the adequate (>4 ppm) and marginal (2-4 ppm) groups for Fe, where 46% and 54% of the studied soil samples were classified as contain adequate and

Table (5): Statistical relationship between the content of available nutrients and some soil properties.

	F. Sand	Silt	Clay	Silt + Clay	O.M %	$CaCO_3$ %	Gypsum	pH	E.C	C.E.C	Macro-elements (ppm)			Micro-elements (ppm)		
											N	P	K	Fe	Mn	Zn
Silt	0.126	-														
Clay	-0.206	0.847	-													
Silt + Clay	-0.043	0.960	0.962	-												
O.M %	0.419	0.814	0.663	0.768	-											
$CaCO_3$ %	-0.275	-0.433	-0.065	-0.103	-0.125	-										
Gypsum %	0.270	0.415	0.185	0.311	0.557	-0.043	-									
pH	-0.083	-0.058	-0.179	-0.124	-0.300	-0.022	-0.456	-								
E.C.	0.170	0.137	0.159	0.154	0.385	0.067	0.551	-0.698	-							
C.E.C.	-0.173	0.878	0.998	0.976	0.686	0.067	0.251	-0.166	0.161	-						
N ppm	-0.171	0.648	0.618	0.658	0.603	-0.087	0.507	-0.266	0.227	0.628	-					
P ppm	0.299	0.601	0.625	0.638	0.766	-0.259	0.209	-0.279	0.485	0.632	0.363	-				
K ppm	-0.134	0.619	0.741	0.708	0.826	-0.074	0.074	-0.187	0.231	0.708	0.633	0.678	-			
Fe	0.285	0.450	0.555	0.524	0.659	0.127	0.342	-0.543	0.664	0.549	0.408	0.741	0.519	-		
Mn ppm	-0.259	0.628	0.723	0.704	0.463	-0.144	-0.036	0.052	0.242	0.732	0.411	0.725	0.735	0.333	-	
Zn ppm	0.208	0.654	0.685	0.697	0.779	0.014	0.474	-0.478	0.719	0.691	0.470	0.859	0.562	0.868	0.583	-
Cu ppm	0.139	0.782	0.837	0.843	0.788	-0.213	0.409	-0.354	0.631	0.884	0.640	0.798	0.700	0.859	0.641	0.913

** Significant at 1 % level * Significant at 5 % level

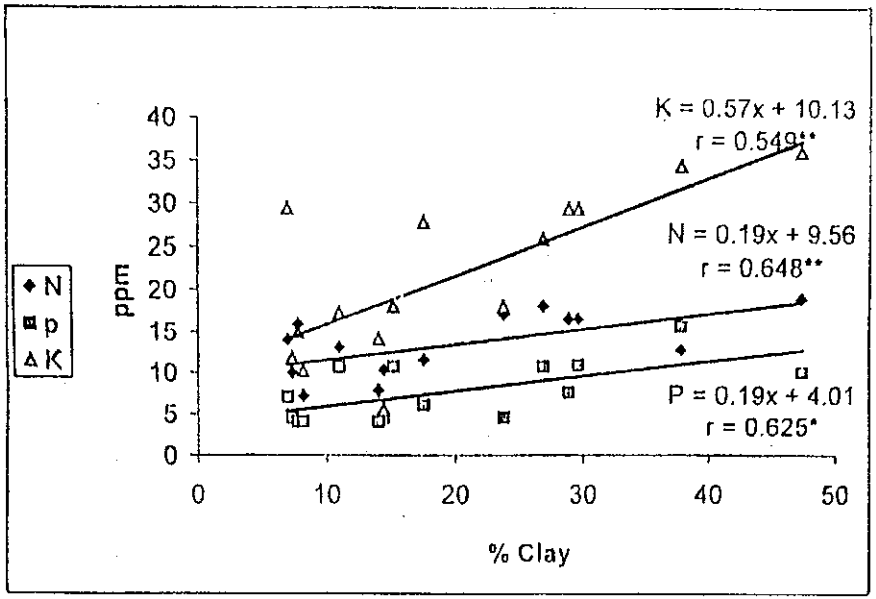

Fig. (2): Statistical correlation between clay and N,P & K

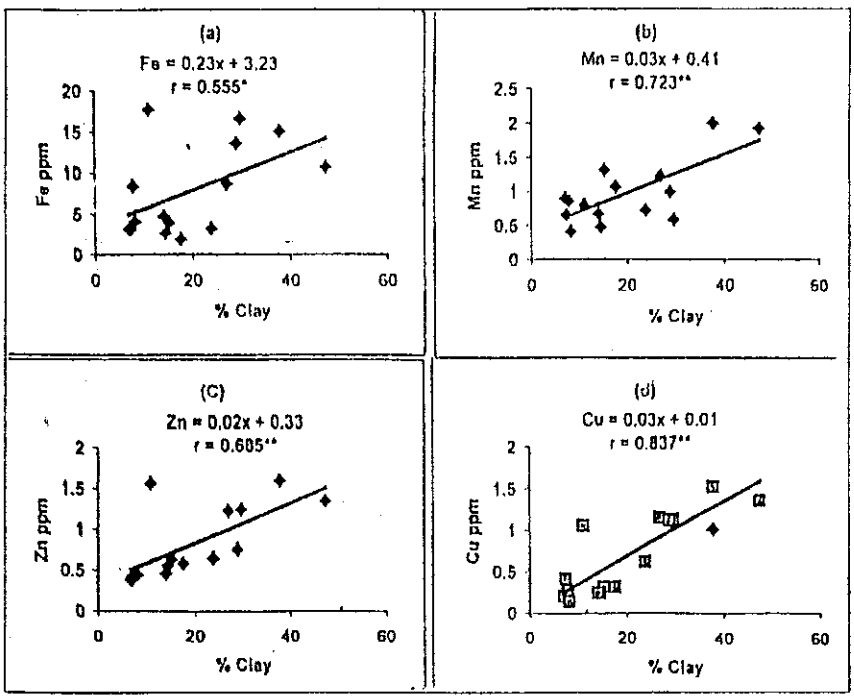

Fig. (3a,b,c,d): Statistical correlation between clay and Fe, Mn, Cu & Zn

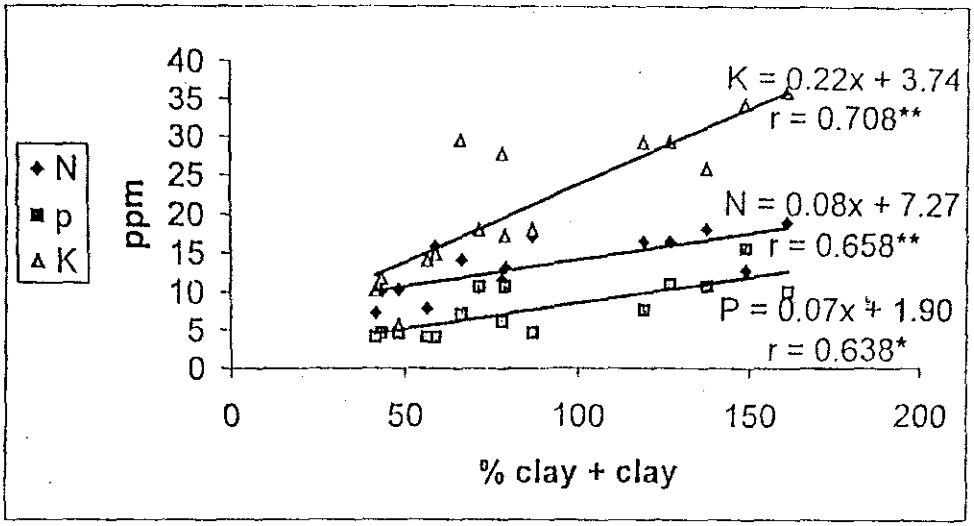

Fig. (4): Statistical correlation between (silt + clay) and N,P & K

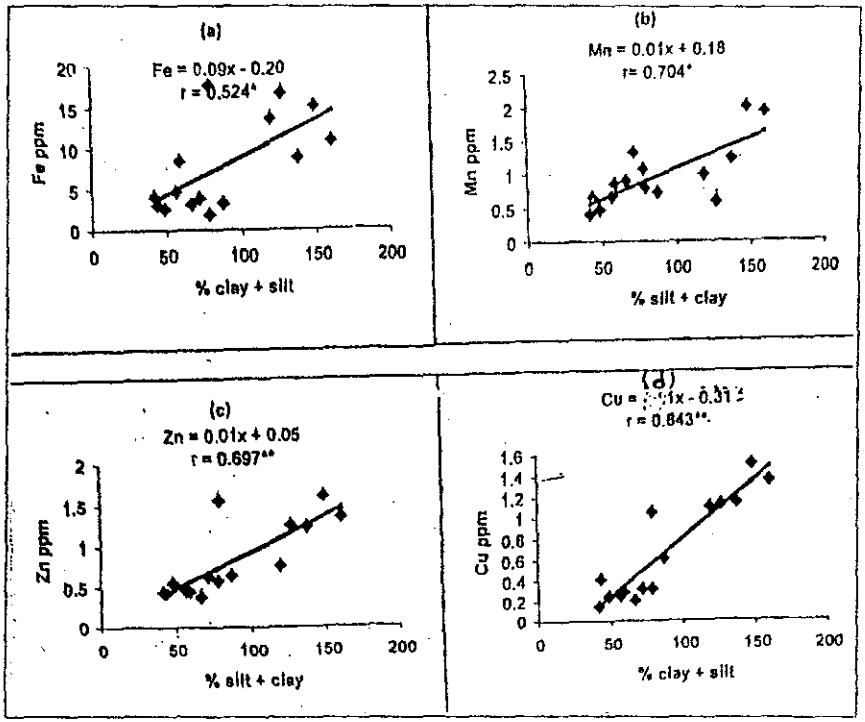

Fig. (5a,b,c,d): Statistical correlation between (silt +clay) and Fe, Mn, Cu & Zn

marginal DTPA-Fe levels. Regarding Mn-content in all soil samples, except Nos. 1 and 3, are considered low in available manganese. Moreover, these soils are considered marginal (1.0-1.5 ppm) in available Zn-content. While the majority of these soils could be considered as low in Cu-content (less than 0.5 ppm Cu).

The statistical relationships between the available nutrients and some soil properties:

Table (5) shows the statistical relationships between the available nutrients, i.e., N,P,K., Fe, Mn, Zn, & Cu and some soils properties. In general, the majority of the obtained correlation values were not enough to be significant, while the fine fraction clay and/or silt were strongly correlated with these nutrients. In addition, either P or K was significantly correlated with the micronutrients under study. Moreover, C.E.C. was also, correlated with them. On the contrary, insignificant correlation coefficients found to be between the previous nutrients and fine sand, $CaCO_3$, gypsum content and soil pH values. Therefore, these results confirmed that the fine charged clay fraction and/or silt represented the effective dominant soil factor affected nutrients availability in such soils as clear in Figs. 2,3,4 and 5.

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دراسات على أراضى إقليم توشكى

١ - مستوى المغذيات النباتية فى أراضى بكر من إقليم توشكى

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الملخص العربي

أختيرت خمسة عشر عينة تربة سطحية تمثل الوحدات الخريطية لأراضى اقليم توشكى البكر الواقعة بين خطى طول ٣٠° ٣٠ ، ٣٢° ٠٠ شرق & خطى عرض ٢٢° ٢٢ ، ٢٣° ٢٦ شمال، وقد قدرت الصفات الطبيعية والكيميائية لهذه العينات.

وأشارت النتائج إلى أن هذه الأرض تتميز بقوام متوسط فى معظمه وهى تميل إلى الجانب القاعدى من حيث قيم Soil pH ويمكن اعتبارها ذات طبيعة جيرية، حيث تزيد نسبة كا ك أ٣ عن ٩٪ فى معظمها بالإضافة إلى محتواها العالى نسبياً من الملوحة الكلية الذائبة ويمكن ترتيب الكيتونات الذائبة بها كالأتى: ص$^{+}$ > كا$^{++}$> مغ$^{++}$> بو$^{+}$، بينما الأيونات تأخذ الشكل الآتى: كل$^{-}$ > كب أ$_{٤}^{-}$> يد ك أ$_{٣}^{-}$. فى معظم العينات تحت الدراسة، وكذلك توضح النتائج أن هذه الأراضى تعتبر فقيرة فى المادة العضوية، ومن ثم محتواها من الأزوت والفوسفور والبوتاسيوم.

وتبين نتائج تقدير المحتوى الكلى من العناصر الصغرى فى التربة أن كمياتها الكلية تتبع الترتيب الآتى: ح> من > خ > نح، بينما الجزء الميسر من الحديد يمكن اعتباره مناسب فى ٧٠٪ من العينات، الجزء الميسر من الزنك يوجد فى وضع حدى فى كل العينات، وبالنسبة لمستوى عنصرى المنجنيز والنحاس فى التربة فإن قيم الجزء الميسر لكليهما يشير إلى أن الأراضى التى تمثلها العينات المأخوذة تعتبر فقيرة فيها.

ولقد وجد إحصائيا أن هناك معاملات ارتباط عالية المعنوية بين كل من مكونى السلت والطين من جهة وبين محتوى التربة من العناصر الغذائية الميسرة من جهة أخرى.