Assiut J. of Agric. Sci., 39 (2) (235-248)

AVAILABILITY OF PHOSPHORUS IN SOILS OF ASSIUT GOVERNORATE, EGYPT.*

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Abstract: To study phosphorus availability in Assiut, the governorate area was divided into 12 transects, that were taken across the Nile Valley in the east-west direction. Soil profiles were selected in each transect according to the Nile valley width. A total of 69 soil profiles were morphologically described. Samples of surface layers of these profiles were collected in the winter of 2003/2004 to evaluate the availability and total levels of phosphorus in soils of Assiut Governorate. The available soil P in the surface soil samples ranged from 0.80 to 82.00 mg/kg. Levels of the available P in the loamy soils were always higher than those of the sandy or clay soils. According to Olsen and Sommers (1982) 32% of Assiut soils are deficient in P. Significant positive correlations were recorded between the available soil P of the studied soils and the organic matter content, electrical conductivity (EC_e), soluble calcium, soluble bicarbonate and total P. The correlations between the available soil P and $CaCO_3$, clay, silt and sand contents were not significant. The total P in the surface soil samples of the studied soils ranged from 1.00 and 3.70 g/kg and varied with the soil texture. The total P content of the loamy soils or the clay soils was much higher than that of the sandy soils.

Keywords: Phosphorus, Availability, Assiut, Nile Valley.

Introduction

The availability of soil P is affected by several soil properties such as soil pH, organic matter, calcium carbonate, soil texture (Kanabo and Gilkes; 1988, Staunton and Leprince, 1996; Hiradate and Uchida, 2004). The maximum P availability in most soils occurs between pH 5.5 and 6.5 (Tisdale et al., 1997). In alkaline soils, P fixation by calcium compounds occurs due to dicalcium and tricalcium phosphate formation which may transform to hydroxiapatite or to flourapatite (Martinez et al., 1984). Phosphorus adsorption on soil colloids decreases as pH increases (Parfitt, 1978). The addition of organic manure was reported to decrease P adsorption and phosphate potential and to increase Olsen extractable P (Bahl and Toor, 2002) and native P mobilization (Toor and Bahl., 1997). Various mechanisms were proposed to explain the influence of organic residues on P availab-ility (Cole et al., 1977). They

*Submitted to the 2nd Conference Of Junior Scientists, Fac. of Agric. Assiut Univ. May.,6,2008.

include (1) the direct contribution of P in a soluble form from the mineralization of the amendment (He et al., 2001) and (2) the competition between the organic anions produced from the residue decomposition and phosphate anions on the adsorption sites (Iyamuremye and Dick, 1996; Tisdale et al., 1997). Organic amendements were also reported to enhance the nutrient cycling, mineralization rates, and the inorganic-P transformation into the available-P form for plants (Iyamuremye and Dick, 1996). Brady and Weil (1999) reported that in calcareous soils, a reaction that occurred between soluble superphosphate fertilizer and $CaCO_3$ formed dicalcium phosphate which changed into tricalcium phosphate with a variable decrease in the solubility. In alkaline or calcareous soils, three factors govern the P concentration in the soil solution. They are (1) size and amount of free $CaCO_3$ (2) the activity of Ca^{2+} ions and (3) the amount of clay (Sims and Ellis, 1983; Tisdale et al., 1997). Zheng et al. (2003) observed a larger increase in the total labile P per unit of added P in coarser-textured soils than in finer-textured ones. Therefore, phosphorus fixation increases while P availability decreases with increasing the clay fraction (Brady and Weil, 1999; Tisdale et al., 1997). The soil test level is elevated in a fine textured soil because it will have a greater supply of available phosphorus at the same soil test level than coarser textured soils (Novais and Kamprath, 1978). This study aims to evaluate the available and total levels of phosphorus in soils of Assiut governorate.

Materials and Methods

Assiut Governorate is located in the middle of Egypt between latitude of 26° 50' to 27° 37′ N and longitude of 30° 39′ to 31° 35′ E. The predominant climate is arid. The daily temperature ranges from 5 to 21°C in winter, and between 20 and 41°C in summer (Said, 1981). Assiut Governorate area was divided into 12 transects, that were taken across the Nile Valley in the east-west direction. Certain soil profiles were selected in each transect according to the Nile valley width (Figure 1). A total of 69 soil profiles were morphologically described.

Soil samples were collected from each profile in the winter of 2003/2004 to assess the available levels of P in Assiut soils. The chemical and physical analyses were measured in the surface samples of Assiut soils. Particle size distribution was measured using the pipette method according to (Richards, 1954; Jackson, 1969). Saturation percentage (SP) was measured as described by Hesse (1998). Organic matter (OM) was determined using the Walkley-

Black method (Jackson, 1973). Soil pH was determined in 1:1 suspension of a soil to deionized water by a glass electrode (Jackson, 1973). Calcium Carbonate ($CaCO_3$) was estimated using a volumetric calcium carbonate calcimeter (Nelson, 1982). Electrical conductivity (EC_e) of the saturated soil paste extract was measured using an electrical conductivity meter (Hesse, 1998). Available Phosphorus (Olsen-P) was extracted by 0.5 M $NaHCO_3$ at pH 8.5 according to Olsen et al. (1954), then it was determined calorimetrically using the chlorostanous phosphomolybdic acid method according to Jackson (1973). Total P was determined by digesting 0.5 g soil with 5 ml concentrated H_2SO_4 and 5 ml H_2O_2 (30%) at 360 °C for 3 hours according to Hedley et al. (1982). The chemical and physical characterizations of these samples are present in Table 1.

Results and Discussion

The levels of Olsen-P in the surface soil samples ranged from 0.80 to 82.00 mg/kg with an average value of 17.91 mg/kg (Table 2). In most cases, this extractable P in the surface layers was higher than in the subsurface ones due to the continuous additions of chemical and organic fertilizers that contain phosphorus. In the studied clay, loamy and sandy soils, the extractable P varied from 0.80 to 26.60 mg/kg with an average value of 12.55, from 1.93 to 82.00 mg/kg with an average value 20.71 mg/kg, and from 2.70 to 29.00 mg/kg with an average value of 16.07 mg/kg, respectively. The mean concentration of the extractable P in the loamy soils was always higher than that of sandy or clay soils under study. In a similar study on some soils of El-Minia Governorate, the extractable P ranged between 0.80 and 58.64 mg/kg as reported by Attia (1988). In sandy calcareous soils the content of extractable soil P was 4.50 mg/kg as reported by El-Desoky and Ragheb (1993). In some soils of Assiut Governorate, the extractable soil P ranged from 3.31 to 69.34 mg/kg (Hala, 2001). The results showed that 14.5% of the surface layers (P4/T1, P5/T1, P2/T5, P5/T5, P4/T6, P6/T6, P2/T9, P6/T9, P7/T9 and P5/T11) do respond to P fertilizers that can be added and 17.4% of these layers (P1/T1, P2/T1, P5/T2, P3/T5, P6/T5, P2/T6, P4/T7, P4/T9, P1/T10, P3/T11, P1/T12 and P5/T12) probably respond to P fertilizers. Olsen and Sommers (1982) reported that the soils that contain the Olsen soil P <5 mg/kg do respond, between 5 and 10 mg/kg probably respond and >10 mg/kg unlikely respond to added P fertilizers.

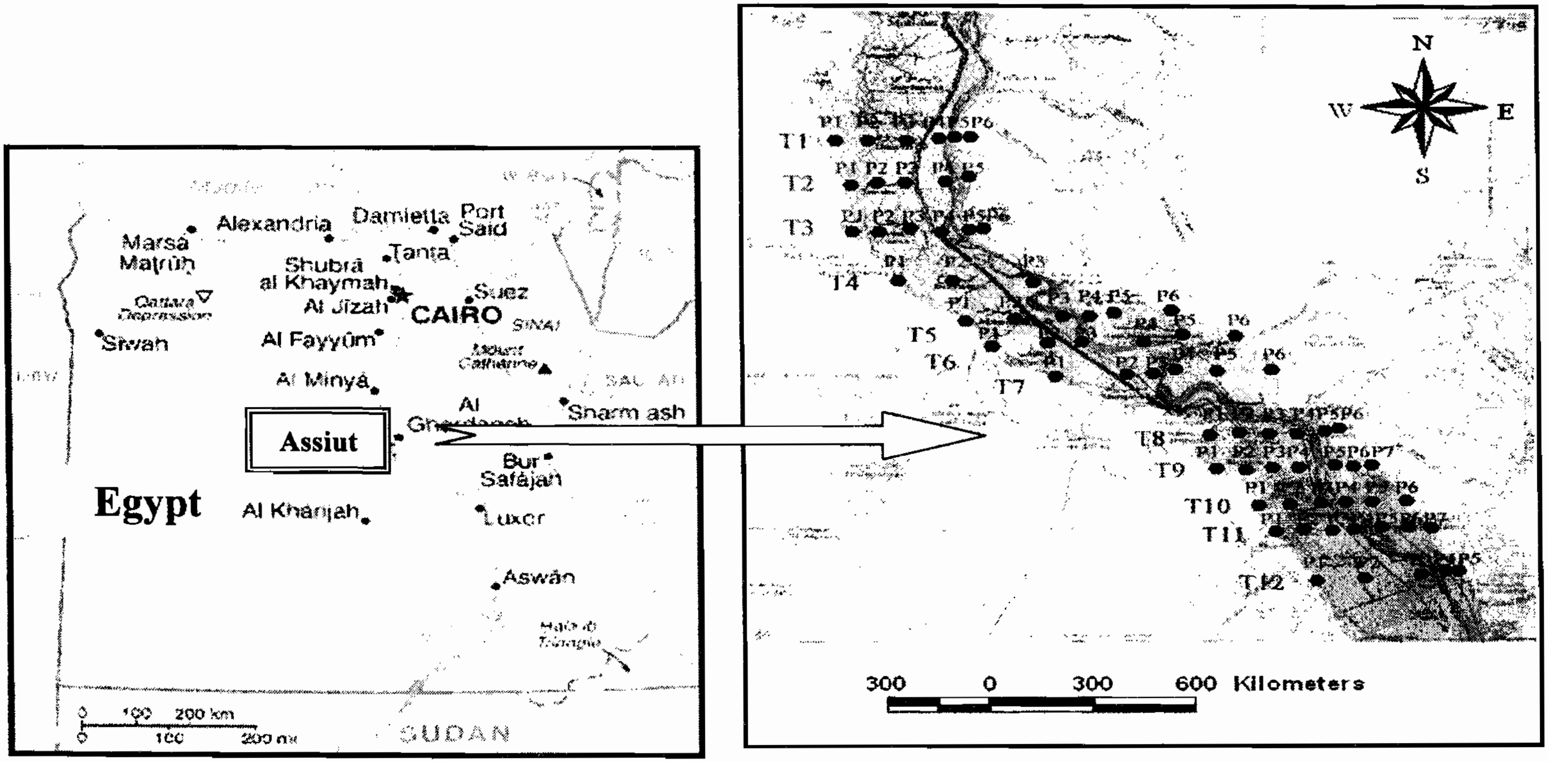

Fig. (1): Location map of soil profiles of the area under study

Table (1): Some physical and Chemical properties of the studied soil profiles.

Prof./Trans.*	Location	Depth (cm)	O.M (%)	$CaCO_3$ (%)	SP** (%)	Particle size Distribution (%)			Texture
						Sand	Silt	Clay	
1/1	Baweett	0-30	1.31	3.79	49.2	54	14	32	SCL***
2/1	Koom-Angasha	0-30	2.10	1.91	55.5	35	48	17	Loam
3/1	El-Mahmoudia	0-25	1.11	1.46	37.8	76	10	14	Sandy loa
4/1	Shalsh	0-30	1.31	2.11	46.5	63	21	16	Sandy loa
5/1	El-Awamer	0-30	0.46	1.32	27.3	84	5	11	Loamy sa
6/1	El-Awamer	0-30	1.58	3.04	59.0	44	15	41	Clay
1/2	Nazelt Salman	0-16	0.68	4.74	20.7	88	2	10	Loamy sa
2/2	Sanbu	0-30	1.59	3.56	59.4	44	34	22	Loam
3/2	Ezebt Mohamed Sheriff	0-30	1.23	2.32	57.0	35	36	29	Clay loam
4/2	Fazara	0-42	1.77	1.22	56.3	42	36	22	Loam
5/2	Dair El-Quseir	28-43	0.19	1.22	34.6	91	3	6	Sand
1/3	Mir	0-35	1.04	4.87	30.0	80	7	13	Sandy loa
2/3	El-Anssar	0-30	1.41	3.00	59.1	40	21	39	Clay loam
3/3	El-Qusia	0-30	0.98	4.13	49.5	62	17	21	SCL
4/3	El-Quseir	0-15	1.89	2.60	51.3	44	32	24	Loam
5/3	El-Quseir	0-22	0.45	1.16	19.8	86	4	10	Loamy sa
6/3	El-Quseir	0-30	1.60	3.53	48.5	53	19	28	SCL
1/4	Ezebt Khashba	0-28	.62	4.85	26.8	89	1	10	Loamy sa
2/4	Romeh	0-40	1.45	1.57	59.0	48	25	27	SCL
3/4	Beni Shokeir	0-20	.91	2.57	30.1	84	6	10	Loamy sa
1/5	Arab El-Amaiem	0-35	0.55	3.73	16.9	89	4	7	Loamy sa
2/5	Manfalut	0-22	2.12	2.45	59.0	44	37	19	Clay loam
3/5	Jazeret El-Hawatel	0-34	1.21	2.01	40.4	68	10	22	SCL
4/5	Shoklekeil	0-30	2.24	6.31	61.4	35	31	34	Clay loam
5/5	Arab El-Shanabla	0-40	1.33	3.06	65.3	24	36	40	Clay
6/5	Ezbet El-Atalah	0-15	0.85	23.85	21.4	87	3	10	Loamy sa
1/6	Beni Adi	0-30	1.09	3.37	63.5	25	23	52	Clay
2/6	El-Mandara	0-30	0.79	2.87	67.9	14	35	51	Clay
3/6	El-Hawateka	0-25	1.03	2.60	45.2	65	17	18	Sandy loa
4/6	Beni Mohamed	0-30	1.33	2.87	52.8	55	26	19	Sandy loa
5/6	Abnub	0-30	1.25	3.08	52.0	53	21	26	SCL
6/6	Arab Motteir	0-20	0.97	13.10	30.3	75	6	19	Sandy loa
1/7	Jahadam	0-35	1.22	4.60	27.3	79	3	18	Sandy loa
2/7	Meseraa	0-30	2.31	3.23	72.3	21	27	52	Clay
3/7	El-Odar	0-25	1.70	3.31	60.0	42	19	39	Clay loam

* Trans. = Transect, Prof. = Profile,

** SP = Saturation percentage

*** SCL= Sandy clay loam

Table (1): Continued.

Prof./Trans.	Location	Depth (cm)	O.M (%)	CaCO₃ (%)	SP (%)	Particle size Distribution (%)			Texture
						Sand	Silt	Clay	
4/7	Jazeret Beni Mor	0-35	1.49	0.96	57.1	31	37	32	Clay loam
5/7	El-Qasar	0-45	2.04	3.41	68.0	32	30	38	Clay loam
6/7	El-Sheikh Seweif	0-20	0.82	14.61	26.0	86	2	12	Loamy sa
1/8	Dronka	0-30	2.25	7.59	75.4	21	20	59	Clay
2/8	Shetteb	0-30	1.90	3.23	74.3	15	26	59	Clay
3/8	Qurqares	0-30	2.30	2.20	67.5	25	27	48	Clay
4/8	El-Mateaa	0-30	1.98	2.90	62.6	34	29	37	Clay loam
5/8	El-Ghorieb	0-30	1.45	3.59	61.7	43	15	42	Clay
6/8	El-Ghorieb	0-20	1.21	17.00	25.3	85	5	10	Loamy sa
1/9	Deir Dronka	0-20	1.68	25.03	37.0	58	15	27	SCL
2/9	Refa	0-30	1.14	2.44	67.9	16	34	50	Clay
3/9	Mosha	0-30	2.01	4.58	71.0	16	38	46	Clay
4/9	Baqour	0-30	1.14	0.89	60.7	52	23	25	SCL
5/9	El-Louka	0-20	2.42	4.09	59.7	37	36	27	Loam
6/9	El-Mattmar	0-30	2.01	2.89	86.4	11	33	56	Clay
7/9	Arab El-Mattmar	0-30	1.61	5.54	76.0	28	20	52	Clay
1/10	Abu El-Hareth	0-30	2.15	7.50	77.3	20	27	53	Clay
2/10	Deweina	0-30	1.34	2.42	69.9	30	25	45	Clay
3/10	Abu Tig	0-25	1.27	2.49	31.5	81	8	11	Sandy loa
4/10	Nazelt El-Melk	0-30	1.81	2.42	63.0	37	34	29	Clay loam
5/10	El-Shamia	0-30	2.28	2.35	64.4	46	35	19	Loam
6/10	Deir Tasa	0-30	2.68	5.42	82.1	25	38	37	Clay loam
1/11	Nazelt El-Laban	0-30	2.21	3.07	67.7	32	36	32	Clay loam
2/11	Nazelt El-Laban	0-30	2.01	2.95	71.5	23	35	42	Clay
3/11	Megrees	0-30	1.48	2.80	61.6	66	16	18	Sandy loa
4/11	Jazeret Megrees	0-15	0.54	0.81	29.1	89	5	6	Sand
5/11	Tel Zaied	0-40	1.34	2.56	54.7	53	28	19	Sandy loa
6/11	El-Sheikh Ali	0-15	2.80	1.32	67.2	31	35	34	Clay loam
7/11	Menshat El-Ekal	0-30	1.71	3.42	60.2	43	25	32	Clay loam
1/12	Deir El-Ganadla	0-23	1.71	16.63	27.6	78	10	12	Sandy loa
2/12	Ezebt El-Marg	0-30	1.78	2.12	69.8	26	24	50	Clay
3/12	El-Waaddla	0-30	1.71	1.69	65.5	43	32	25	Loam
4/12	Jazeret El-Haman	0-20	2.59	2.70	62.9	30	38	32	Clay loam
5/12	El-Hamamia	0-30	1.51	3.79	66.7	27	32	41	Clay

Therefore, it should be emphasized to carry out a precultivation test for P in order to save money and time for the farmers.

The extractable P in about 32% of Assiut soils was less than 10 mg/kg. So, these soils have to be fertilized with P fertilizers.

Correlations between the Olsen-P and some soil properties

Significant correlations were found between Olsen extractable P of the surface layers of the studied soils and some soil properties of these layers. A significant positive correlation was obtained between the extractable P soil and the organic matter content ($r=0.294^{*}$) of the surface soil layers. Similar results were reported by Zohdy and Badr El-din (1983) in a virgin sandy soil, by El-Desoky and Ragheb (1993) in sandy calcareous soils of Assiut, and by Abd El-Galil and Ibrahim (2001) in some soils of Sohag Governorate. Organic matter that was added to the P-fixing soils was shown to increase levels of the available P in these soils due to the mineralization of organic matter (Iyamuremye and Dick, 1996).

The correlation between the Olsen soil P and electrical conductivity (EC_e) of the saturated paste of the surface soil layers was positively significant ($r=0.250^{*}$). The availability of P increased slightly with increasing the soil salinity due to increasing the concentrations of Cl^- and SO_4^{2-} anions in the saturation extract and lowering the soil pH (Hassan et al., 1970). The salinity levels between 6-6.6 dS/m caused increases in the soil available P (Maliwal and Paliwal, 1971).

The extractable soil P of the surface samples was highly significant and positively correlated to the bicarbonate ions in these samples ($r=0.360^{**}$). Helyar et al. (1976) found that HCO_3^- and Cl^- were the only anions that might compete with phosphorus for the adsorption sites. Moreover, Simpson (1964) recorded a substitution of soluble carbonates for the phosphates in the apatite structure.

The correlation coefficient between the extractable soil P and the soluble calcium in the saturated soil paste extract of the surface layers was found to be positively and highly significant ($r=0.582^{**}$). The amount of the released Ca from phosphate rock dissolution was reported to be proportional to the rate of phosphorus release (Khasawneh and Doll, 1978).

The correlation between the extractable soil P and each of $CaCO_3$, clay content, silt content and sand content was not significant (r=0.142, -0.048, 0.074 and -0.009, respectively) in the surface layers of the soils under study. Olsen-P was also found to be significantly correlated to the total soil P ($r=0.272^{*}$).

Table (2): Some chemical properties and concentrations of the $NaHCO_3$-extractable P (Olsen-P) as well as the total P of the surface layer of the studied soils.

Prof./Trans.	Depth (cm)	pH	EC_e dS/m	Ca^{2+} (mmol/L)	$HCO3^-$ (mmol/L)	Olsen-P (mg/kg)	Total P (mg/kg)
1/1	0-30	7.96	1.30	2.60	4.15	9.80	1468.75
2/1	0-30	7.67	0.80	2.62	4.84	5.30	2031.25
3/1	0-25	7.95	0.88	2.50	4.57	16.00	1843.75
4/1	0-30	7.73	0.84	3.10	4.09	3.10	2560.00
5/1	0-30	8.44	0.88	1.08	5.00	2.70	1706.25
6/1	0-30	7.72	0.80	3.77	1.55	11.10	2812.50
1/2	0-16	7.60	1.60	4.87	3.50	29.00	1637.50
2/2	0-30	7.70	2.60	4.66	4.28	6.40	1375.00
3/2	0-30	7.61	1.27	3.23	3.78	27.40	2062.50
4/2	0-42	7.60	0.72	1.96	4.46	31.60	2281.25
5/2	28-43	7.90	0.70	1.42	2.79	5.32	1968.75
1/3	0-35	7.93	1.38	3.01	7.69	28.60	1143.75
2/3	0-30	7.80	1.15	2.34	5.02	5.50	2750.00
3/3	0-30	8.51	6.10	3.08	11.72	20.90	2343.75
4/3	0-15	7.82	1.83	3.61	7.63	82.00	2656.25
5/3	0-22	8.03	0.93	3.13	4.37	23.30	1593.75
6/3	0-30	7.70	0.84	2.09	4.93	14.20	1406.25
1/4	0-28	8.46	1.20	1.46	7.60	20.70	1231.25
2/4	0-40	7.76	1.12	2.22	5.21	23.90	1718.75
3/4	0-20	8.24	1.30	2.22	5.20	6.10	1137.50
1/5	0-35	8.08	0.80	1.58	4.93	11.60	1437.50
2/5	0-22	7.76	2.10	2.46	7.53	3.00	2218.75
3/5	0-34	7.95	0.85	1.71	5.00	0.01	1656.25
4/5	0-30	7.95	3.33	2.86	5.76	11.60	3700.00
5/5	0-40	7.75	0.73	2.54	3.50	27.20	1000.00
6/5	0-15	8.02	1.52	1.98	7.40	10.00	1562.50
1/6	0-30	8.00	0.68	1.04	3.92	17.40	2218.75
2/6	0-30	8.15	1.33	1.30	4.61	9.00	1843.75
3/6	0-25	8.07	1.24	1.87	6.41	30.80	1718.75
4/6	0-30	7.90	0.70	2.08	3.10	1.93	1281.25
5/6	0-30	8.07	0.94	1.51	4.84	10.50	1750.00
6/6	0-20	8.53	3.02	1.74	9.63	2.90	1168.75
1/7	0-35	7.75	1.24	3.00	8.30	31.44	1312.50
2/7	0-30	7.80	1.86	3.25	5.43	23.40	1781.25
3/7	0-25	7.91	1.72	2.78	6.22	25.90	1593.75

Table (2): Continued.

Prof./Trans.	Depth (cm)	pH	EC_e dS/m	Ca^{2+} (mmol/L)	$HCO3^-$ (mmol/L)	Olsen-P (mg/kg)	Total P (mg/kg)
4/7	0-35	7.55	0.90	2.39	4.41	5.10	1775.00
5/7	0-45	7.81	1.22	1.95	5.04	14.40	1656.25
6/7	0-20	8.12	1.30	2.81	7.52	13.90	1087.50
1/8	0-30	7.80	1.90	3.80	6.40	25.70	2125.00
2/8	0-30	7.67	0.76	1.95	4.40	10.24	1843.75
3/8	0-30	7.71	0.83	2.39	4.88	12.60	1656.25
4/8	0-30	7.93	0.88	2.71	5.80	19.12	2037.50
5/8	0-30	7.98	1.02	2.08	5.01	17.25	1312.50
6/8	0-20	8.15	1.00	2.45	6.10	26.30	1312.50
1/9	0-20	8.04	1.54	3.64	6.11	50.40	1781.25
2/9	0-30	8.25	0.92	0.78	5.20	2.40	2125.00
3/9	0-30	7.98	0.83	2.15	6.00	17.40	1750.00
4/9	0-30	7.77	0.72	1.94	4.50	5.12	1593.75
5/9	0-20	7.80	1.67	4.65	8.60	51.10	1843.75
6/9	0-30	7.84	0.90	1.60	5.10	0.80	2750.00
7/9	0-30	7.52	1.84	0.78	6.10	4.88	2062.50
1/10	0-30	7.75	1.89	3.20	4.10	9.44	2750.00
2/10	0-30	7.87	0.91	1.55	5.20	13.20	1937.50
3/10	0-25	8.12	0.80	2.00	6.30	17.48	2031.25
4/10	0-30	7.76	0.72	2.33	4.70	15.76	2093.75
5/10	0-30	7.62	1.14	3.75	6.10	25.80	2750.00
6/10	0-30	7.80	1.07	2.42	7.00	47.00	2812.50
1/11	0-30	7.60	1.30	4.17	7.60	10.44	2437.50
2/11	0-30	7.83	0.75	1.90	5.00	2.56	2625.00
3/11	0-30	7.73	0.83	2.23	5.40	12.44	2625.00
4/11	0-15	7.90	0.72	2.33	4.30	11.84	2625.00
5/11	0-40	7.90	0.95	1.94	4.50	5.64	2031.25
6/11	0-15	7.74	0.81	1.94	5.20	13.56	2562.50
7/11	0-30	7.90	1.10	1.94	6.30	46.00	2750.00
1/12	0-23	8.13	1.87	2.71	7.50	8.88	1718.00
2/12	0-30	7.75	1.09	2.13	6.50	26.60	2031.25
3/12	0-30	7.86	1.29	1.97	8.12	17.24	2000.00
4/12	0-20	7.88	1.10	2.78	7.15	22.44	3250.00
5/12	0-30	7.70	0.79	2.07	5.21	8.32	2437.50

Total P

The total P in the surface soil layers of the studied soils ranged from 1.000 and 3.700 g/kg with an average value of 1.973 g/kg (Table 2). The lowest level was found in the clay soil of P5/T5 while the highest one was in the loamy soil of P4/T5. The total P varied from 1.000 g/kg in P5/T5 to 2.813 g/kg in P6/T1 in the studied clay soils, from 1.144 g/kg in P1/T3 to 3.700 g/kg in P4/T5 in the studied loamy soils and from 1.088 g/kg in P6/T7 and 2.625 g/kg in P4/T11 in the studied sandy soils. The average total P content of the loamy soils or the clay soils (an average of 2.065 and 2.009 g/kg, respectively) was much higher than that of the sandy soils (an average of 1.533 g/kg). Abd El-Galil and Ibrahim (2001) found that the total P level of some soils of Sohag Governorate ranged from 0.100 to 2.250 g/kg. Agbenin and Tiessen (1995) found that the total P of the soil increased with decreasing the particle size. Moreover, Hanely and Murphy (1970) indicated that the highest total P level was in the clay fraction while the lowest one was in the sand fraction. The total P was also found to be high in the soils under an intensive cropping system, while its low content was recorded in the newly reclaimed and non cultivated soils (Abd El-Galil and Ibrahim, 2001).

Correlations between the total P and some soil properties

The total P of the studied soils was highly significantly and negatively correlated to the soil pH (r=-0.319**). This result is in a full agreement with that of Abd El-Galil and Ibrahim (2001). However, some workers indicated that the total P was positively correlated to the soil pH (Zhang et al., 1997; Abekoe and Tiessen, 1998). A highly significant and positive correlation was also obtained between the total soil P and the organic matter content of these soils (r=0.538**). The same results were reported by Abd El-Galil and Ibrahim (2001). Significant and positive correlations were also recorded between the total soil P and each of the clay and silt fractions with r coefficients of 0.245* and 0.459**, respectively. Lekwa and Whiteside (1986) and Abd El-Galil and Ibrahim (2001) found that the relation between clay content and total P was frequently correlated. However, the relationship between total soil P and the sand fraction was highly significant but negative (r=-0.396**). In some Egyptian soils, the lowest total P content was associated with sandy and calcareous soils, while the highest one was found in the heavy textured alluvial soils (Ibrahim et al., 1980; Diab et al., 1994). Agbenin and Tiessen (1995) showed that the total P of the sand and silt fractions was correlated to the total Ca in these fractions.

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صلاحية الفوسفور فى أراضى محافظة أسيوط، مصر.*

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لدراسة صلاحية الفوسفور فى اراضى اسيوط تم تقسيم مساحة محافظة أسيوط الى 12 خطا متعامدا على نهر النيل و يحتوى كل خط على عدد من القطاعات الأرضية يتوقف على عرض الوادى. وكان العدد الكلى للقطاعات المدروسة 69 قطاعا حيث تم حفرها و فحصها مورفولوجيا و جمعت عينات التربه خلال شتاء 2003/ 2004. حيث تم استخلاص وتقديرالفوسفور الميسر والفوسفور الكلى و كذلك تقدير بعض الصفات الكيميائية والطبيعية للعينات السطحية لهذة الاراضى. وذلك لتقييم مستويات الفوسفور الميسر و الفوسفور الكلى فى اراضى محافظة اسيوط و تتراوح قيم الفوسفور المستخلص بواسطة طريقة أولسن فى الطبقات السطحية من 0.80 الى 82.00 ملجم/كجم. اظهرت النتائج ان متوسط مستوى الفوسفور فى الأراضى الطميية تكون أعلى من كل من الأراضى الرملية أوالطينية. و أن حوالى 32% من اراضى محافظة اسيوط تعانى نقصا فى محتواها من الفوسفور الميسر للنباتات نتيجة انها تحتوى على مستويات من الفوسفور المستخلص بطريقة أولسن اقل من أو يساوى 10.0 ملجم/كجم وبالتالى فانها تحتاج للتسميد بألاسمده الفوسفاتية. كما اوضحت النتائج أن هناك علاقة معنوية موجبة بين الفوسفور المستخلص بهذه الطريقة و كل من محتوى التربة من المادة العضوية، التوصيل الكهربى لعجينة التربة المشبعة، الكالسيوم الذائب، البيكربونات الذائبة والفوسفور الكلى. اما العلاقة بين الفوسفور المستخلص بطريقة أولسن وبين كل من محتوى التربة من كربونات الكالسيوم، الطين، السلت و الرمل فكانت غير معنوية. اظهرت نتائج تحليل أراضى محافظة أسيوط ان الفوسفور الكلى فى الطبقات السطحية يتراوح من 1.000 الى 3.700 جم/كجم وقد تفاوتت هذه القيم على حسب قوام التربة. وأن ألاراضى الطميية وكذلك ألاراضى الطينية ذات متوسط مستويات من الفوسفور الكلى عالية جدا مقارنة بالاراضى الرملية.

* بحث مقدم إلى المؤتمر العلمي الثاني لشباب الباحثين بكلية الزراعة جامعة أسيوط، 6 مايو 2008.