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Evaluation of Phosphorous and Potassium Status in Soils of Assiut Governorate

Al- Sayed, H. M. [1]; [*]G. A. S. Elgharably[2]; A. S. A. Abdel-Mawgoud[1] and M. A. Eissa[2]
[1]Soils and Water, Dept., Fac.of Agric., Al-Azhar Univ., Assuit, Egypt.
[2]Soils and Water. Dept., Fac. of Agric., Assuit Univ., Assuit, Egypt.
[*]E-mail: galal.elgharably@aun.edu.eg

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Abstract

Optimal use of nutrients based on soil analysis can improve crop productivity and minimize environmental pollution. Therefore this study aimed to assess forms of both potassium and phosphorus in soils of Assiut and the relationship between both elements and some soil properties. The study area was divided into 10 transects and 54 soil profiles were selected. Soil samples from two depths (0-30 and 30- 60 cm) at each location were collected then they were analyzed by standard methods. Available and total content of both phosphorus and potassium were measured.

The correlation matrix of soil properties shows that several physical and chemical variables were correlated with each other especially, CaCO3, OM, pH, EC and CEC. Soil salinity (EC) of 90% of soil samples were less than 2 dS/m. Soil reaction (pH) of Assiut Governorate ranged from 7.22 to 8.92 with average value of 7.98. The soil organic matter (SOM) content of Assiut governorate ranged from 0.33 to 4.09% with average value of 1.51 %. Available phosphorus was low in 63.9%, medium in 21.3% and high in 14.8% of the soil samples. Available phosphorus was low in 63.9%, medium in 21.3% and high in 14.8% of the soil samples. Available potassium was low in 16.7% soil samples and 60.2% of soil samples were medium. The remaining 23.2% of soil samples were high. Soil Nutrient Index of the study area was found in category of low phosphorus, medium potassium and high OMC.

Keywords: *Nutrient index, soil salinity, soil reaction, organic matter, available phosphorus, available potassium, fertility status.*

Introduction

Soil characterization in relation to evaluation of soils fertility status for an area or region is an important aspect in context of sustainable agriculture production. Because of imbalanced and inadequate fertilizer use coupled with low efficiency of other inputs, the response (production) efficiency of chemical fertilizer nutrients has declined tremendously under intensive agriculture in recent years. Variation in nutrient supply is a natural phenomenon and some of them may be sufficient where others deficient. The stagnation in crop productivity cannot be boosted without judicious use of macro- and micronutrient fertilizers to overcome existing deficiencies or imbalances (Meena *et al.*, 2006).

The deficiency of nutrients has become major constraint to productivity, stability and sustainability of soils. Soil fertility is an important factor, which determines the growth of plant. It depends on the concentration of N, P, K organic and inorganic materials, micronutrients and water. In general soil chemical fertility and in particular lack of nutrient inputs is a major factor in soil degradation (Hartemink, 2010). Soil aggregate status usually deteriorates rapidly if soil is repeatedly cropped with little supply of organic matter. to the soil, require extensive cultivation and provide minimal vegetative cover. There are various ways of addition and losses of nutrients as take place in soil. These nutrient cycling make the balance of organic and inorganic soil constituents. In recent years organic and inorganic fertilizers and pesticides are being widely used by farmers in agriculture to increase the yield and production of cultivatable plants. The yield and quality of crop depends upon the fertilizers and presence of micronutrients. The soil condition is of great importance because it is a universal medium for plant growth, which supplies essentials nutrients to the plants (Narkhede *et al*., 2011). But due to excess use of fertilizers, the physico-chemical status of soil is being changed (Kamble *et al*., 2013).

The current work aims to assess the soil fertility status in Assiut Governorate as affected by some soil properties

Materials and Methods

The study area (Assiut Governorate) is located 300 km south Cairo between 26° 50' to 27° 37' N latitude and 30° 39' to 31° 35' E longitude (Map 1). The absolute altitude (Map 1). The absolute altitudes vary from 41 to 77 m. The climatic conditions in the region are typical arid. The rainfall is practically nil except some light showers that rarely fall during winter and some unrecorded flash floods coming from the Eastern desert. The daily temperature, ranges from 5 to 21°C in winter, and between 20 and 41°C in summer.

Assiut Governorate area was divided into 10 transects, that were taken across the Nile Valley in the east-west direction, with a distance almost about 8.0 km between consecutive transects leaving 12 km north the first one and south the last one. Number of soil profiles were selected in each transect according to the Nile valley width in each transect using the global positioning system (GPS) for localizing each profile. All soil profiles in each transect had known longitudes at one definite latitude. Soil samples were collected in May 2014 from fifty four locations of Assiut Governorate under different cropping pattern. Soil samples from two depths (0- 30 and 30- 60 cm) at every location were collected using auger and stored in polythene bags. The collected soil samples were air dried, crushed gently then pass through 2.0 mm sieve to obtain a uniform representative sample. The processed soil samples were analyzed by standard methods for some chemical properties (particles size distribution, $CaCO_3$, OM, pH, EC and CEC) according to Page *et al*. (1982).

The soil nutrient index was calculated according to the procedure given by Pathak (2010) using the following equation:

$$\text{Nutrient index} = (N_L \times 1 + N_M \times 2 + N_H \times 3)/ N_T$$

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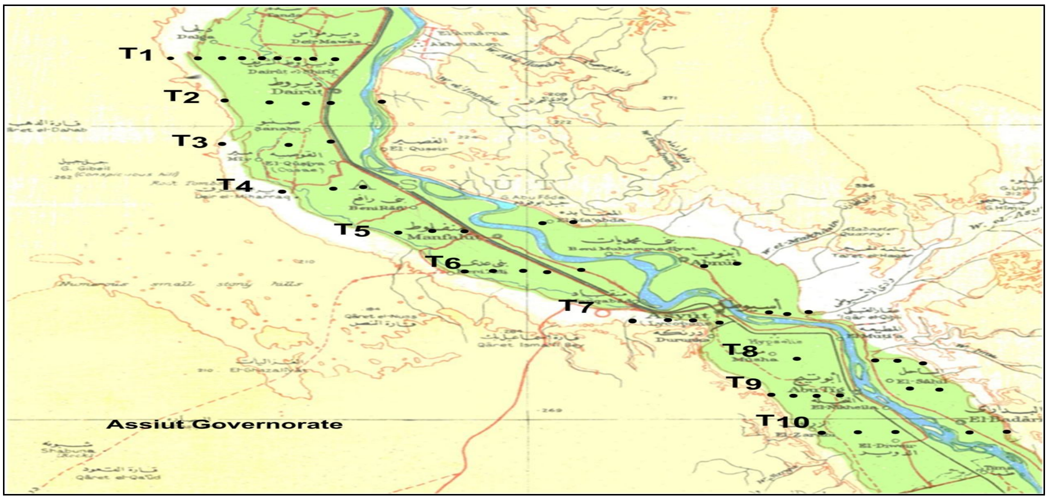
Where: N_L number of sampling falling in low classes of nutrient status

N_M number of sampling falling in medium classes of nutrient status

N_H number of sampling falling in high classes of nutrient status

N_T total number of sampling analyzed for a given area

Available soil phosphorus was extracted by $NaHCO_3$ method buffered at pH 8.5 according to Olsen *et al*., (1954) and was measured by spectrophotometer at 660 um, wavelength. Available potassium (soluble + exchangeable) was extracted using 1 N NH_4OAc at pH 7 as described by Carson (1980) and the difference between K extracted using water and that extracted using 1N NH_4OAc gives a measure of the exchangeable K. Total phosphorus and potassium were extracted by H_2SO_4+ $HClO_4$ digestion as described by Jackson (1973).



Map (1). Transects distribution and the studied profile in Assiut governorate

The samples were categorized according to the rating of Kumar *et al.* (2009) and it is shown in Table (1).

Table 1. Limits for rating values of the tested soils

Classification of pH values			
Neutral	Slightly alkalin	Moderately alkalin	Strongly alkalin
7.0-7.5	7.5- 8.0	8.0- 8.5	> 8.5
Classification of total soluble salt content (EC dS m-1)			
No deleterious effect on crop	Critical for germination	Critical for salt sensitive crop	Injurious to most crops
< 1.0	1.0- 2.0	2.0- 3.0	> 3.0
parameters	Low	medium	high
O.M. (%)	< 0.86	0.86- 1.29	> 1.29
Av. P (kg ha-1)	< 12.5	12.5- 25.0	> 25
Av. K (kg ha-1)	< 135	135- 335	> 335

OM = organic matter Av. = available P= phosphorus K= potassium

Results and Discussion

Some chemical properties of the studied soils

Soil salinity (ECe) of Assiut Governorate ranged from 0.36 to 7.8 with an average value of 1.37 ds/m (table 2).The EC_e values of the studied soils increased with depth and these results are in agreement with those of Amin *et al.* (2008). Soil salinity expresses as electrical conductivity (EC) values were categorized on the basis of limiting suggested by Kumar *et al*. (2009). To evaluate soil salinity, the obtained results showed that 37.0, 52.8, 7.4 and 2.8 % of the samples were found in category of no deleterious effect on crop, critical for germination, critical for salt sensitive crop and injurious to most crops, respectively (table 3). It was noticed that most of all soil samples were found in normal category (EC < 2 dS/m). The normal electrical conductivity may be ascribed to leaching of salts to lower horizons (Singh and Mishra, 2012).

Soil reaction (pH) of Assiut Governorate ranged from 7.22 to 8.92 with average value of 7.98 (table 2). In general, the pH values in the studied area increased with depth. This may be due to the hydrolysis of calcium carbonate to bicarbonate and hydroxyl ions resulting in high soil pH. Also, the relative high pH value may be attributed to the presence of high degree of base saturation (Meena *et al.,* 2006).

Table 2. ECe and pH of the investigated soils of Assiut Governorate.

District Name	Depth	ECe (dS/m)	pH (1: 2.5)	District Name	Depth	ECe (dS/m)	pH (1: 2.5)
Dairout	0-30	0.720	7.27	El-Kosia	0-30	1.130	7.930
	30-60	0.830	7.420		30-60	1.150	7.930
	0-30	0.840	7.730		0-30	1.310	7.940
	30-60	0.890	7.730		30-60	1.360	7.970
	0-30	0.900	7.770		0-30	1.500	7.970
	30-60	0.900	7.800		30-60	1.600	7.980
	0-30	0.910	7.800		0-30	1.650	7.980
	30-60	0.940	7.810		30-60	1.670	8.000
	0-30	0.980	7.830		0-30	0.670	7.220
	30-60	0.990	7.840		30-60	0.680	7.430
	0-30	1.000	7.840		0-30	0.720	7.480
	30-60	1.000	7.840		30-60	0.730	7.660
	0-30	1.000	7.860		0-30	0.790	7.770
	30-60	1.100	7.860		30-60	0.870	7.860
	0-30	1.100	7.870	Manfalout	0-30	0.910	7.880
	30-60	1.100	7.880		30-60	0.910	7.890
	0-30	1.120	7.900		0-30	0.950	7.890
	30-60	1.130	7.910		30-60	0.950	7.890

ECe (No deleterious effect on crop) = <1 (Critical for germination) =1-2
(Critical for salt sensitive crop) =2-3 (Injurious to most crops) = >3
pH Neutral = (7-7.5) Slightly alkaline= (7.5-8) Moderately alkaline = (8-8.5) Strongly alkaline = (>8.5)

Continue Table 2.

District Name	Depth	ECe (dS/m)	pH (1: 2.5)	District Name	Depth	ECe (dS/m)	pH (1: 2.5)
Manfalout	0-30	0.98	7.91	Abo-Teag	0-30	0.98	7.91
	30-60	0.98	7.91		0-30	0.98	7.91
	0-30	0.99	7.93		0-30	1.01	8.00
	30-60	1.00	7.94		30-60	1.01	8.01
	0-30	1.01	7.94		0-30	1.06	8.04
	30-60	1.03	7.99		30-60	1.10	8.04
	0-30	1.03	7.99		0-30	1.11	8.06
	30-60	1.05	7.99		30-60	1.16	8.07
	0-30	1.24	8.02	Sahel Seleem	0-30	0.87	7.87
	30-60	1.33	8.04		30-60	0.90	7.87
Assiut	0-30	1.45	8.06		0-30	0.90	7.87
	30-60	1.69	8.10		30-60	0.94	7.88
	0-30	1.81	8.17		0-30	0.96	7.89
	30-60	1.85	8.20		30-60	0.96	7.91
	0-30	2.09	8.26		0-30	0.99	7.92
	30-60	2.10	8.26		30-60	1.00	7.94
	0-30	2.13	8.30		0-30	1.00	7.96
	30-60	2.20	8.38		30-60	1.00	7.96
	0-30	0.63	7.61		0-30	1.00	7.98
	30-60	0.71	7.64		30-60	1.00	8.00
	0-30	0.78	7.72	Al-Ghanaim	0-30	1.43	8.14
	30-60	0.79	7.74		30-60	1.51	8.15
	0-30	0.80	7.77	Sedfa	0-30	1.20	8.10
	30-60	0.82	7.81		30-60	1.23	8.10
	0-30	0.82	7.82		0-30	1.55	8.18
	30-60	0.83	7.85		30-60	1.57	8.21
Abnoub	0-30	1.07	8.01		0-30	1.58	8.21
	30-60	1.10	8.01		30-60	1.58	8.33
	0-30	1.15	8.01	El-Badari	0-30	1.23	8.12
	30-60	1.19	8.02		30-60	1.23	8.13
El- Fath	0-30	1.90	8.01		0-30	1.27	8.13
	30-60	6.36	8.05		30-60	1.27	8.14
	0-30	2.31	8.42		0-30	1.63	8.40
	30-60	5.10	8.69		30-60	1.72	8.47
	0-30	7.10	8.80		0-30	2.00	8.57
	30-60	7.80	8.92		30-60	2.16	8.63

ECe (No deleterious effect on crop) = <1 (Critical for germination) =1-2
(Critical for salt sensitive crop) =2-3 (Injurious to most crops) = >3
pH Neutral = (7-7.5) Slightly alkaline= (7.5-8) Moderately alkaline = (8-8.5) Strongly alkaline = (>8.5)

Data presented in table (3) show the of category soil reaction (pH) as suggested by Kumar *et al*. (2009). Two samples were neutral (7.0- 7.5), 65 samples were slightly. alkaline (7.5- 8.0), 36 samples were moderately alkaline (8.0- 8.5) and 5 samples were strongly alkaline (> 8.5). The neutral to alkaline pH may be attributed to the reaction of applied fertilizer material with soil colloids, which resulted in the retention of basic cations on the exchangeable complex of the soil (Sharma *et al.,* 2008 and Singh & Mishra, 2012).

Table 3. Soil salinity (EC) and soil reaction (pH) distribution in different district of the studied area in Assiut governorate

District Name	Sample No.	Soil salinity (EC dS/m)				Soil reaction (pH)			
		deleterious effect on crop (< 1.0)	Critical for germination (1.0 - 2.0)	Critical for salt sensitive crop (2.0 - 3.0)	Injurious to most crops (> 3.0)	Neutral (7.0-7.5)	Slightly alkaline (7.5-8.0)	Moderately alkaline (8.0-8.5)	Strongly alkaline (>8.5)
Dairout	18	3	14	1	0	0	16	2	0
El-kosia	14	9	5	0	0	1	12	1	0
Manfalout	14	4	4	3	3	1	9	4	0
Assiut	16	4	10	2	0	0	7	8	1
Abnoub	4	1	3	0	0	0	0	4	0
El-Fath	6	4	2	0	0	0	3	1	2
Abo-Teag	8	2	4	2	0	0	3	3	2
Sahel Seleem	12	5	7	0	0	0	4	8	0
Al-Ghanaim	2	1	1	0	0	0	2	0	0
Sedfa	6	3	3	0	0	0	4	2	0
El-Badary	8	4	4	0	0	0	5	3	0
Assiut Governorate	108	40	57	8	3	2	65	36	5

The soil organic matter (SOM) content of Assiut governorate ranged from 0.33 to 4.09 with average value of 1.51 % (table 4). In general, SOM content decreased with depth and away from Nile River in the two sides. High temperature and good aeration in the soil may increase the rate of oxidation of organic matter resulting in reduction of organic carbon content (Meena *et al*., 2006).

Available soil phosphorus in the studied area of Assiut Governorate ranged between 2.73 and 110.08 with an average value of 15.74 ppm (table 4). The available soil phosphorus increased whenever hitting away from the Nile River in both side east or west. This may be due to that most of these soils are uncultivated desert soils located on both east and west side of Nile valley, mostly with sandy texture, having quite amounts of P-bearing primary minerals (Ragheb *et al*.,2010). Available potassium in the studied region of Assiut Governorate ranged between 38 and 710 with an average value of 252.79 ppm (table 4). In general, available potassium decreased with depth in most the studied soil profiles. Also, it was noticed that the available potassium coincided with total one since it increased toward south direction. Again, this may be due to the relative high content in silt fraction in most studied profiles in the south area of Assiut Governorate (Ghosh and Debnath, 2010 and Britzke *et al*., 2012).

Table 4. Different of Organic matter, available phosphors and potassium in the studied soil profile of Assiut Governorate.

District Name	Depth	O.M %	Ava. P (ppm)	Ava. K (ppm)	District Name	Depth	O.M %	Ava. P (ppm)	Ava. K (ppm)
Dairout	0-30	0.23	81.87	340	El-Kosia	0-30	1.44	15.46	295
	30-60	0.23	7.13	234		30-60	1.52	3.29	360
	0-30	0.30	17.18	455		0-30	1.67	7.63	279
	30-60	0.46	11.18	169		30-60	1.70	4.85	232
	0-30	0.46	13.85	387		0-30	1.70	4.32	138
	30-60	0.68	4.55	200		30-60	1.74	4.78	114
	0-30	0.68	6.83	209		0-30	1.77	7.13	217
	30-60	0.74	3.94	141		30-60	1.82	3.93	210
	0-30	0.83	79.55	404		0-30	0.61	7.84	169
	30-60	0.91	12.53	205		30-60	0.30	4.94	38
	0-30	0.99	7.45	467		0-30	2.24	8.72	288
	30-60	1.06	3.93	210		30-60	1.21	4.00	221
	0-30	1.08	70.94	100		0-30	2.05	5.05	187
	30-60	1.29	4.55	141		30-60	0.83	3.88	182
	0-30	1.44	110.08	474	Manfalout	0-30	2.08	29.65	619
	30-60	1.44	10.65	220		30-60	1.39	5.98	254
	0-30	1.44	12.77	582		0-30	1.23	4.81	185
	30-60	1.44	4.85	293		30-60	0.30	2.73	67

	Low	Medium	High
OM	< 0.86	0.86-1.29	>1.29
P- Ava.	< 12.5	12.5-25	>25
K- Ava.	<135	135-335	>335

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Table 4. Different of Organic matter, available phosphors and potassium in the studied soil profile of Assiut Governorate.

District Name	Depth	O.M%	Ava.P (ppm)	Ava. K (ppm)	District Name	Depth	O.M %	Ava.P (ppm)	Ava.K (ppm)
Manfalout	0-30	1.44	4.34	174	Abo-Teag	0-30	2.24	13.43	429
	30-60	1.29	3.04	152		30-60	2.16	8.57	327
	0-30	0.91	10.71	126		0-30	1.74	12.63	196
	30-60	0.68	6.86	106		30-60	0.36	4.69	67
	0-30	1.77	11.60	344		0-30	0.99	6.47	90
	30-60	1.16	6.95	227		30-60	0.68	4.20	45
	0-30	2.01	7.27	282		0-30	3.09	76.35	575
	30-60	1.29	6.92	140		30-60	2.20	58.39	710
	0-30	2.31	23.74	56.8	Sahel Seleem	0-30	2.70	8.86	389
	30-60	0.76	6.53	194		30-60	0.54	3.99	141
Assiut	0-30	2.31	23.74	56.8		0-30	0.67	8.75	125
	30-60	0.76	6.53	194		30-60	0.24	3.56	57
	0-30	4.09	21.05	89.6		0-30	1.03	14.53	321
	30-60	2.28	41.58	454		30-60	0.91	7.95	258
	0-30	1.93	5.62	509		0-30	1.39	18.46	167
	30-60	1.44	5.74	290		30-60	1.21	5.35	124
	0-30	1.29	6.17	161		0-30	3.93	56.49	284
	30-60	0.76	7.81	76		30-60	1.69	14.41	203
	0-30	2.47	16.93	278		0-30	2.70	56.03	441
	30-60	2.12	7.09	211		30-60	2.01	20.13	303
	0-30	2.78	8.46	273	Al-Ghanaim	0-30	2.08	25.89	267
	30-60	1.77	15.14	359		30-60	1.23	7.03	171
	0-30	1.93	13.60	315	Sedfa	0-30	2.08	13.60	227
	30-60	0.85	5.42	238		30-60	1.23	6.72	196
	0-30	2.08	26.76	275		0-30	2.47	54.43	623
	30-60	2.12	17.86	246		30-60	2.36	9.74	174
Abnoub	0-30	1.33	6.86	464		0-30	2.55	20.30	309
	30-60	1.09	4.20	279		30-60	1.03	4.69	138
	0-30	1.33	9.86	168	El-Badari	0-30	2.31	14.83	281
	30-60	0.91	3.77	143		30-60	1.39	4.43	184
El- Fath	0-30	1.85	4.55	171		0-30	2.78	26.87	459
	30-60	2.39	3.54	71		30-60	1.45	8.60	256
	0-30	1.94	6.44	338		0-30	2.01	19.16	580
	30-60	0.73	3.98	111		30-60	1.63	11.48	309
	0-30	1.15	23.55	143		0-30	3.24	64.20	357
	30-60	0.42	6.08	104		30-60	2.06	33.86	211

	Low	**Medium**	**High**
OM	< 0.86	0.86-1.29	>1.29
P- Ava.	< 12.5	12.5-25	>25
K- Ava.	<135	135-335	>335

The organic matter content was low (< 0.86%) in 22.2% of soil samples and 18.5% soil samples were medium in OM (0.86- 1.29%). The remaining 59.26% of soil samples were highin OM (> 1.29%). Considering the concept of "Soil Nutrient Index" the soils of study area were found in category of high fertility status for organic matter content, 2.4, (table 5). Available phosphorus was low (< 12.5 ppm) in 63.9% of soil samples and 21.3% soil samples were medium (12.5- 25.0 ppm). The remaining 14.8% of soil samples were high (> 25 ppm). Considering the concept of "Soil Nutrient Index" the soils of study area were found in category of low fertility status for available phosphorus, 1.5, (table 5). Available potassium was low (< 135 ppm) in 16.7% soil samples and 60.2% soil samples were medium (135- 335 ppm). The remaining 23.2% of soil samples were high (> 335 ppm). Considering the concept of "Soil Nutrient Index" the soils of study area were found in category of medium fertility status for available potassium, 2.1, (table 5).

Table 5. Organic matter, available phosphorus and available potassium distribution in different district of the studied area in Assiut governorate

District Name	Sample No.	Organic matter (%)					Available phosphorous (ppm)					Available Potassium				
		Low (<0.86)	Medium (0.86-1.29)	high (>1.29)	Nutrient index	Fertility rating	Low (<12.5)	Medium (12.5-25)	High >25	Nutrient index	Fertility rating	Low (<135)	Medium (135-335)	high (>335)	Nutrient index	Fertility rating
Dairout	18	5	3	10	2.3	Medium	10	4	4	1.7	Medium	1	10	7	2.3	Medium
El-kosia	14	5	3	6	2.1	Medium	13	1	0	1.1	Low	2	11	1	1.9	Medium
Manfalout	14	4	4	6	2.1	Medium	12	1	1	1.2	Low	4	8	2	1.9	Medium
Assiut	16	2	1	13	2.7	High	8	6	2	1.6	Low	2	10	4	2.1	Medium
Abnoub	4	0	2	2	2.5	High	4	0	0	1	Low	0	3	1	2.3	Medium
El-Fath	6	4	1	1	1.5	Low	5	1	0	1.2	Low	3	2	1	1.7	Medium
Abo-Teag	8	2	1	5	2.4	High	4	2	2	1.8	Medium	3	2	3	2	Medium
Sahel Seleem	12	2	2	8	2.5	High	6	4	2	1.7	Medium	3	7	2	1.9	Medium
Al-Ghanaim	2	0	1	1	2.5	High	1	0	1	2	Medium	0	2	0	2	Medium
Sedfa	6	0	2	4	2.7	High	3	2	1	1.7	Medium	0	5	1	2.2	Medium
El- Badary	8	0	0	8	3	High	3	2	3	2	Medium	0	5	3	2.4	high
Assiut Governorate	108	24	20	64	2.4	High	69	23	16	1.5	Low	18	65	25	2.1	Medium

The correlation matrix of soil properties

The correlation matrix of soil properties shows that several physical and chemical variables were correlated with each other (table 6). Available phosphorus content of soil was insignificant and positively correlated with silt (r= 0.193) and clay (r= 0.045). It was insignificant and negatively correlated with $CaCO_3$ (r= -0.118) and soil reaction, pH, (r= -0.049). Available phosphorus was significant and positively correlated with soil salinity (0.197*). It was high significant and positively correlated with both soil organic matter (r= 0.515**) and cation exchangeable capacity (r= 0.258**). Total phosphorus content of soil was insignificant and positively correlated with silt (r= 0.192), calcium carbonate (r= 0.039) and soil reaction (r= 0.166). It was insignificant and negatively correlated with soil salinity (r= -0.007). It was high significant and positively correlated with clay (r= 0.395**), soil organic matter (r= 0.558**), cation exchangeable capacity (r= 0.277**), available phosphorus (r= 0.285**), available potassium (r= 0.336**) and total potassium (r= 0.643**). Calcium carbonate in considerable amounts will decrease the phosphorus availability by forming apatite of low solubility. Organic matter might have increased the solubility of phosphate in soils. According to Tisdale *et al.* (1997), about 50% of phosphorus is found in organic form and decomposition of organic matter produces humus which forms complex with Al and Fe and protects the P fixation. The organic anions compete with phosphate ions for the binding sites on the soil particles or these anions may chalet with aluminum, iron and calcium and thus decrease phosphate-precipitating power of these cations (Gupta *et al.*, 1999). Samavati and Hossinpur (2006) showed that available P (P- extracted by Olsen method) was significantly correlated with calcium, iron and aluminum to form calcium phosphate and aluminum iron oxides (Al-Fe-P). This result indicates that these fractions probably can be used by plant. So that with increasing organic matter Olsen-P was increased (Fan *et al.*, 2007). Available P showed a significant negative correlation with $CaCO_3$; thereby indicating that increase in $CaCO_3$ content may lead to P fixation on CaCO3 surface (Sharma, *et al.*, 2008).

Table 6. correlation coefficient (r) among some physic-chemical properties and forms of both Phosphorous and Potassium.

	Silt	Clay	$CaCO_3$	O.M	pH	ECe	CEC	P-Avai	K-Avai	K – Tot.	P-Tot.
Silt	1										
Clay	0.234*	1									
$CaCO_3$	-0.558**	-0.036	1								
O.M	0.427**	0.296**	-0.201*	1							
PH	-0.282**	0.023	0.550**	-0.086	1						
ECe	-0.096	-0.134	0.033	0.122	0.147	1					
CEC	0.570**	0.450 **	-0.424**	0.556**	-0.266**	-0.050	1				
P-Avai	0.193	0.045	-0.118	0.515**	-0.049	0.197*	0.258**	1			
K-Avai	0.396**	0.214*	-0.275**	0.504**	-0.129	0.001	0.579**	0.482**	1		
K-Tot.	0.277**	0.319**	0.055	0.478**	0.257**	-0.020	0.317**	0.171	0.394**	1	
P-Tot.	0.192	0.395**	0.039	0.558**	0.166	-0.007	0.277**	0.285**	0.336**	0.643**	1

Kumar *et al*., (2009) found a positive non-significant correlation (r = 0.085) between available P and organic carbon. Also, they found that the available phosphorus and clay was found to be significantly and positively correlated (r= 0.316) with each other because the retention of added phosphorus increased with an increase of clay. Kumar *et al*. (2013) observed a positive and significant correlation between organic matter and available phosphorus (r= 0.714).

Positive insignificant correlation of electrical conductivity was found with available potassium (r = 0.001) while there was negative insignificant correlation with soil reaction (r = - 0.129). Available potassium found to be positive and significant correlated with clay content (r = 0.214^{*}). It might be due to the presence of most of the mica (biotite and muscovite) in finer fraction. It was positive and highly significant correlation with each of silt, organic matter, cation exchangeable capacity and available potassium. This might be due to creation of favorable soil environment with presence of organic matter. Similar relationship was also reported by Chouhan (2001). It was observed that available potassium negatively and highly significant correlated with $CaCO_3$ content. Total potassium showed positive insignificant correlation with $CaCO_3$ content (r= 0.055) and available phosphorus (r= 0.171) while it showed negative insignificant correlation with soil salinity (r= -0.02).

Total potassium was positive and highly significant correlated with each of silt, clay, organic matter, soil reaction, cation exchangeable capacity and available potassium. A significant positive effect of clay on available K indicates that the availability of K increases with an increase in clay content (Swami, 2000). Sharma *et al*. (2008) found a significant and positive correlation between available K and soil reaction (pH). A significant positive correlation was found between available potassium with EC (r = 0.142*).This was attributed due to facts that interlayer collapse of clay mineral structure (Waghmare *et al*., 2009). Kumar *et al*. (2013) observed a positive and significant correlation between organic matter and available potassium (r= 0.3505). This might be due to creation of favorable soil environment with presence of high organic matter (Waikar *et al*., 2014)

Cation exchangeable capacity was insignificant and negatively correlated with soil salinity (r= -0.050) while it was highly significant and negatively correlated with $CaCO_3$ (r= -0.424^{**}) and soil reaction, pH, (r= -0.266^{**}). It was high significant and positively correlated with silt (r= 0.57^{**}), clay (r= 0.45^{**}) and soil organic matter (r= 0.556^{**}). Soil salinity was insignificant and positively correlated with $CaCO_3$ (r= 0.033), organic matter (r= 0.122) and soil reaction (r= 0.147). It was insignificant and negatively correlated with silt (r= -0.096) and clay (r= -0.134). Soil reaction (pH) was insignificant and positively correlated with clay content (r= 0.023) while it was insignificant and negatively correlated with organic matter (r= -0.086). It was highly significant and negatively correlated with silt (r= -0.282**) and it was highly significant and positively correlated with CaCO3 content (r= 0.550**). Organic matter content was highly significant and positively correlated with silt (r= 0.427**) and clay (r= 0.296**) while it was significant and negatively correlated with CaCO3 content (r= - 0.201*). Calcium carbonate content was highly significant and negatively correlated with silt (r= -0.558**) while it was insignificant and negatively correlated with clay content (r= -0.036), clay content was significant and positively correlated with silt (r= 0.234*).

It might be concluded that the soils of Assiut Governorate showed considerable content of organic matter with reasonable available potassium while they are suffering from phosphorus deficiency. Build up of organic carbon status by different means is a practicable tool in our hands to minimize deficiency area of these soils with reference to phosphorus. The soil properties pH, EC and OM are the main characteristics playing major role in controlling the availability of macronutrients. These factors could be manipulated in order to combat any present or future deficiencies of macronutrients in these soils. Most soils in Assiut contain abundant soil potassium (K) reserves, and it is often assumed that there are no problems with soil K status. Assessment of the ability of soils to release K for plant uptake is important for proper management of K in crop production. On the basis of these results farmers are advised to use integrated nutrient management practice to maintain optimum concentration of all the essential nutrients for plants. Farmers are also advised to add biofertilizers containing organic carbon.

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تقييم حالة الفوسفور والبوتاسيوم فى أراضى محافظة أسيوط

حسن محمد السيد [١] ، جلال احمد صالح الغرابلى[٢]، على سيد على عبد الموجود[١]، ممدوح عبدالحفيظ السيد عيسى[٢]

[١]قسم الاراضى والمياه، كلية الزراعة، جامعة الأزهر– أسيوط، مصر.

[٢] قسم الاراضى والمياه، كلية الزراعة، جامعة أسيوط، مصر.

الملخص

الاستخدام الأمثل للعناصر الغذائية المعتمد على تحليل التربة يمكن أن يحسن من إنتاجية المحاصيل ويقلل أثرها الضار على البيئة. وتهدف هذه الدراسة إلى تقيم صور كل من البوتاسيوم والفوسفور فى أراضى أسيوط والعلاقة بين كلا العنصرين وخواص التربة. ولذلك تم تقسيم منطقة الدراسة إلى ١٠ خطوط عرضية وتم إختيار ٥٤ قطاع تربة وجمع عينات أرضية ممثلة للعمق (٠-30 و٦٠-30) من كل موقع وتم تحليلها بالطرق القياسية وتم قياس الفوسفور والبوتاسيوم الكلى والميسر.

وقد أظهرت النتائج وجود إرتباط بين عديد من خواص التربة الطبيعية والكيميائية وبعضها البعض خاصة كربونات الكالسيوم ، والمادة العضوية ، وتفاعل التربة ، وملوحتها ، والسعة التبادلية الكاتيونية. أوضحت الدراسة أن ٩٠% من العينات يحتوى على ملحية اقل من ٢ ديسمنز/م وبالنسبة لتفاعل التربة فقد تراوح بين ٧,٢٢ و ٨,٩٢' وكان محتوى المادة العضوية يتراوح بين ٠,٣٣ و ٤,٠٩% وكان الفوسفور الميسر منخفض فى ٦٣,٩ % من العينات، و متوسط ٢١,٣ % ' وعالى فى ١٤,٨ % من العينات. وكان البوتاسيوم الميسر منخفض فى ١٦,٧ % من العينات ' ٦٠,٢ % من العينات متوسط' والباقى ٢٣,٢ % من العينات عالى. وكان معامل التغذية للنبات فى منطقة الدراسة منخفض بالنسبة للفوسفور' ومتوسط بالنسبة للبوتاسيوم ' وعالى فى محتوى المادة العضوية.