Journal of Environmental Studies [JES] 2010. 5:21-32
Original Paper

Phosphorus Status in Soils of Great Groups in Qena Governorate

Ragheb H. M. A.[1], Attia K. K.[2], Ali Abd El-Galil[3*], and Abeer, A. A. Bakr[4]
Soils and Water, Dep., Faculty of Agric., Assiut University[1.2].
Soils and Water, Dep., Faculty of Agric., Sohag University[3].
Soils and Water, Dep., Faculty of Agric., South Valley University[4].

Rec. 1 Nov, 2010 Accpt. 16 Janu 2011

Abstract
The present. investigation was carried out to study the phosphorus status of different soil great – groups present in Qena Governorate .The soil in Qena Governorate is belonged to the following great – groups :Vtt, Eftt, Epqt and Eott. One hundred and five location samples distributed all over the entire area representing the soils of each great group in each territory of Qena Governorate were prepared. The P status of the soils of each great –group was assessed using a variety of chemical extraction methods. A pot experiment was also carried out to study the supplying power of P using Reygrass plants. The obtained results shows that:- The bicarbonate extractable inorganic P (NaHCO3-Pi) in the studied soil samples of different great – groups showed a wide variations that cooped with different chemical of these soils . The amount of Pi in the surface layers of the soils of all great-groups were noticeably higher than that of sub-surface ones. The bicarbonate extractable organic P (NaCO3-Po) contents in the studied soils were different between soils of –great groups and among the soils of each great – groups. The values of total bicarbonate extractable phosphorus (NaHCO3-Pt) showed a considerable variation in Pt among various samples. The data also indicated that Pt in soil generally decreased as the soils became coarse in texture, low in organic content and in total CaCO3 content. P uptake by Raygrass was positively and significantly ($P<0.05$) correlated with both bicarbonate extractable P forms Pi and Po as well as the total bicarbonate extractable phosphorus Pt .The pearson simple correlation coefficients for the P uptake against Pi, Po and Pt were 0.7817**,0.7823**and 0.8215**, respectively.

Key Words: Bicarbonate, phosphorus, soils, groups.

Introdaction

South Valley Governorates (Assiut, Sohag, Qena and Aswan) are considered as of the most important regions in Egypt. Egyptian government depends upon this region in land expansion to increase the cultivated areas and agricultural production. Due to agricultural expansion, many lands of the interference zone between the Nile Valley and the desert plateau are being cultivated. Generally, most of the desert soils are sandy in texture, poor in both organic matter and available nutrients content and calcareous with alkaline pH. Under such conditions, considerable amounts of the available forms plant nutrients, especially phosphorus, are usually subjected to rapid transformation to less available or unavailable forms. Therefore, heavy application of phosphatic fertilizers is a routine work followed to supply the plant with the required amounts of phosphorus.

Soil phosphorus takes several chemical forms depending on the chemical and physical properties of the soil. (Barber 1984; and Mengel, 1985). Phosphorus availability is governed by large number of soil and crop factors (Abd El-Galil and Ibrahim, 2001). Among the most limiting factors are soil pH, $CaCO_3$ and organic matter content which affect soil fertility as well as physical

* Corresponding author:
Dr. A. Abd El-Galil
🖂Ali_Abdelgalil@yahoo.com

conditions and biological activities, (Khalil *et al*., 2004). Most of the previous studies were concerned with the forms of P, its availability and P adsorption/desorption properties of the soils without giving much attention to the great diversity originally presented between the soils great-groups (Nasr 1994; and Abd El-Hamed, 1998). Planning for enhancing P fertility should conceder the variations among soils great-groups and gives much attention to the effects of different pedogenic properties on the status of P in soils. The present investigation aims to study the P status and its forms in the soils of different great groups.

Materials and methods

Soil samples belonging to great groups in Qena Governorate were taken from agricultural regions on both sides of the Nile River, as well as the potential expansion region for the new reclamation projects. The soil map of Egypt prepared by the Soils and Water Resources Research Council of the Academy of Scientific Research and Technology was used to locate the soil great groups present in Qena Governorate.

As shown in (fig 1). the soils in Qena Governorate are belonged to the following soil great groups: Haplotorrerts (Vtt), Torrifluvents (Eftt), Torriorthents (Eott), and Quartzipsamments (Epqt). All the studied soil great sub-groups were located as arid and subarid regions according to USDA (United State Department of Agriculture) Soil Taxonomy (Soil Survey Staff, 1998).

One hundred and five (105) soil location samples distributed all over the entire area representing the soils of each great groups present in each territory of Qena Governorate were prepared. Soil location samples were made in 20 transectors on both sides of the Nile River. (Figure 1). shows the soil of location samples. Soil samples were taken from surface (0.00-0.30 m) and subsurface (0.30-0.60 m) layers.

2. 2- Forms of Soil Phosphorus:

To study the different forms of soil phosphorus of the great-group distinguished in Qena Governorate, surface and sub-surface samples of only 105 soil location samples which represent the different soil great-group were selected (22, 23, 13 and 47) soil location samples represent the Vtt, Eftt, Epqt and Eott soils of great-groups, respectively. Besides being essential for the characterization of soil in each of the selected sites, those data might be help in explaining the status of phosphorus in the studied soils.

The phosphorus status of the soils of each great-group was assessed using a variety of chemical extractions as follows:

1- P_{Ot} = total Olsen's extracted P ($NaHCO_3$-P_t)
2- P_{Oi}= Olsen's extracted inorganic P ($NaHCO_3$-P_i)
3- P_{Oo}= Olsen's extracted organic P ($NaHCO_3$-P_o)

The available P in the soil was extracted according to (Olsen *et al*., 1954). Extraction was done using 0.5 M $NaHCO_3$ pH 8.5, 1: 20 soil extract ratio, 30 min shaking, and remarked as Olsen's extracted inorganic P (P_{Oi}). In addition, portion of $NaHCO_3$ extract was digested with potassium persulphate as described by (Bowman, 1989). and analyzed for P, and remarked as total Olsen's extractable P (P_{Ot}). The concentration of Olsen's extracted organic P (P_{Oo}) was calculated as the difference between P_{Ot} and P_{Oi}. Phosphorous in all extracts was determined using the chlorostannous-phosphomolybdic acid method (Jakson, 1973).

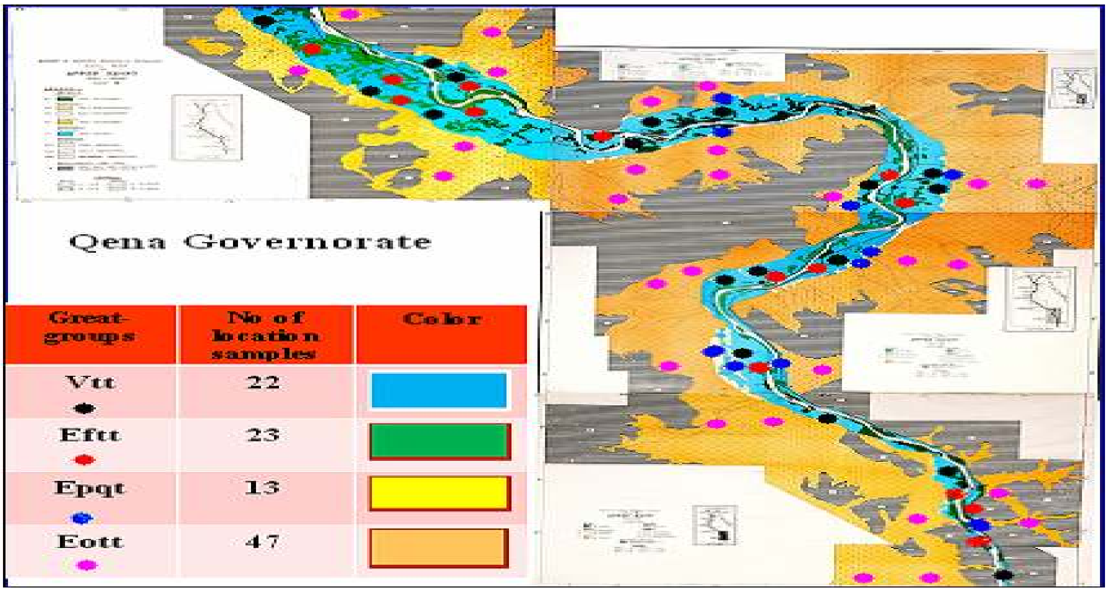

Fig 1: Soil map of Qena governorate shows the soil great-groups and location samples.

2. 3- Phosphorous supplying power of soils:

A pot experiment was carried out during the winter season of 2006/2007 in the greenhouse conditions at the experimental farm, Faculty of Agriculture at Qena, South Valley University, to study the supplying power of P using Ryegrass (*Lolium perenne L.*) plants as a test plants as described by (Soltan *et al*., 1993). Surface and Sub-surface samples of the 105 soil location samples which represent the different soils of great-groups were used (22, 23, 13 and 47) soil location samples represent the Vtt, Eftt, Epqt and Eott soils great groups, respectively.

One kg of each soil sample was placed in a plastic pot of 10 cm diameter and 15 cm in depth and irrigated with distilled water. In December 10, (2006). twenty seeds of Ryegrass were planted in each pot. After germination, seedlings in each pot were thinned to 10 plants/pot. Soil moisture was maintained at the field capacity during the course of the experiment. Nitrogen and potassium were applied to each pot in the form of ammonium nitrate and potassium sulfate, respectively. No phosphate was applied to any pot. Five weeks after sowing, plants were harvested.

At harvesting time, plants of each pot were washed with distilled water, oven-dried at 70°C, and kept for analysis. A 0.2 g portion of dried plant material was digested using the sulfuric-perchloric acids mixture and then phosphorous concentration in the digest was determined colorimetrically using the stannous chloride phosphomolibdic-sulfuric acid as described by (Jackson, 1973).

Results and discussion

As shown in (Fig 1), soils of the cultivated area in Qena Governorate belong to four great groups, Haplotorrerts (Vtt), Torrifluvents (Eftt), Quartzipsamments (Epqt) and Torriorthents (Eott). It might be important to summarize some of the general description of these great-groups according to the manual of the Soil Map of Egypt (Egyptian Academy of Scientific Research and Technology, 1982).

The soil great-groups distinguished in Qena Governorate are the following:

1- Haplotorrerts (Vtt): The soils of this great-group represent the vertisols of the arid climates, being of a heavy clayey texture. The dominant clay mineral is the montmorillonite. This great-group is represented by 22 location samples equally distributed on both sides of the River Nile valley.
2- Torrifluvents (Eftt): The soils of this great-group are of alluvial nature formed in recent water deposited

sediments mainly in flood plains and deltas of rivers, representing those of arid climates. They are alkaline or calcareous and may be salty. This great-group is represented by 23 location samples; most of them are located in the east side of the River Nile.

3- Quartzipsamments (Epqt): The soils of this great group represent the freely drained quartz in mid or low latitudes. They have a moisture regime other than tropic and contain a sand fraction that is 95% more quartz, zircon and tourmaline that do not weathered to liberate iron or aluminum, therefore, they have no mottles. This great-group is represented by 13 location samples.

4- Torriorthents (Eott): The soils of this great-group represent the dry and salty variant. They have a tropic moisture regime with a sandy skeletal size class. This great-group is represented by 47 location samples..

1- Phosphorus forms in the soils of soil great-groups present in Qena Governorate:-

To study the different forms of soil phosphorus available in the soils of great-groups distinguished in Qena Governorate, 105 location samples (22, 23, 13 and 47) representing the soils of Vtt, Eftt, Epqt and Eott great- groups, respectively) were prepared, and soil samples from surface and subsurface (0.00-0.30 and 0.30-0.60 m, respectively) were collected. Table (1) shows ranges and means of the measured amounts of $NaHCO_3$-extractable P forms (inorganic, P_i organic, P_o and total, P_t) in the surface and subsurface soil layers of the soil great groups present in Qena Governorate. (Figures 2 and 3). show the averages of Pi, Po, and Pt in the surface and sub-surface soil layers, respectively, of the studied soil great-groups.

1-1: Bicarbonate extractable inorganic P (NaHCO3-Pi):

The bicarbonate extractable inorganic P ($NaHCO_3$-P_i) in the studied soil samples of different soil great-groups shows a wide variations that cooped with the different chemical properties of these soils (Table 1). In the surface soil layers the $NaHCO_3$-P_i ranged between 10.14- 30.42 ppm with an average of 20.3±5.3 ppm, 9.71- 25.95 ppm with an average of 17.83±4.5 ppm, 9.47-22.64 with an average of 16.06±4.1 ppm, and 3.11-12.50 ppm with an average of 7.81±2.4 ppm in the surface layer of Vtt, Eftt, Epqt, and Eott soil great group, respectively. In the sub-surface layers the amounts of $NaHCO_3$-P_i were ranged between 5.62- 25.46 ppm with an average of 15.54±5.5 ppm, 6.71- 19.42 ppm with an average of 13.07±4.0 ppm, 4.10- 12.87 ppm with an average of 8.49±3.1 ppm, and 2.13-8.96 ppm with an average of 5.55±1.9 ppm, respectively (Table 4). Similar results were obtained by (Faragallah, 1995; Abd El-Hamed 1998; Hammad *et al*., 1998; and Abd El-Galil and Ibrahim, 2001).

Based on the averages of $NaHCO_3$-P_i in the surface layers (Fig 2), soils belong to the Vtt, Eftt and Epqt great-groups have relatively moderate to high levels of bicarbonate extractable P_i (20.3±5.3 ppm, 17.83±4.5 ppm, and 16.06±4.1 ppm, respectively), that are fairly enough to cover the requirements of most of usually grown crops. These soils are located in the Nile valley, noticeably have very high to high clay contents, considered as agricultural fields and subjected to continuous application of P fertilizers. These could be explained such moderately to high levels of bicarbonate extractable P_i. On the other hand, soils representing the Eott great-group have low amounts of available $NaCO_3$-P_i (7.81±2.36 ppm), and thus most probably well suffering from the deficiency of P. Most of these soils are uncultivated desert soils located on both east and west side of Nile valley, mostly with sandy texture, having low amounts of P-bearing primary minerals, and very poor in organic matter contents. All these factors are considered as acceptable explanations for the low amounts of $NaCO_3$-P_i in the soils of Eott great-group.

It is quite clear that the amounts of available bicarbonate extractable P_i in the surface layers of the soils of all great groups are noticeably higher than that of the sub-surface layers (Fig 2 and 3). The high amount of available P_i in the surface layers compared to the subsurface layers might have been attributed to the increases of clay and organic matter contents in the surface layers, in one side, and the continuous application of P-fertilizers to the surface layers of the studied soils, in another side. Phosphorous is considered to be relatively immobile in the soil system (Johnson *et al*., 1997), and with continuous application of P fertilizers, there well be a high potential for P_i accumulating in the surface layers of the soils. On the other hand, continuous cropping of monocoat plants that have a deeper root system may have been responsible, to some extent, for the depletion of Pi in the sub-surface layers.

Great Groups[@]		**HCO_3- Extractable P (ppm)[$]**		
		P_i	**P_o**	**P_t**
		Surface layer (0.00-0.30 m)		
Vtt	**Range**	10.14-30.42	2.03-11.64	12.17-42.06
	Mean	20.3±5.3	6.8±2.3	27.1±7.0
	CV[#]	26.8	23.1	21.9
Eftt	**Range**	9.71-25.95	5.5-11.16	15.21-37.11
	Mean	17.83±4.5	8.33±1.4	26.16±5.2
	CV	17.6	16.5	13.9
Epqt	**Range**	9.47-22.64	5.20-9.24	14.67-31.88
	Mean	16.06±4.1	7.22±1.3	23.28±4.6
	CV	27.1	14.7	19.2
Eott	**Range**	3.11-12.50	1.19-6.52	4.30-19.02
	Mean	**7.81±2.4**	**3.86±1.3**	**11.66±3.0**
	CV	**27.0**	**37.0**	**23.4**
		Sub-surface layer (0.30-0.60 m)		
Vtt	**Range**	5.62-25.46	1.74-9.70	7.36-35.16
	Mean	15.54±5.5	5.72±2.1	21.26±7.2
	CV	28.7	32.8	25.9
Eftt	**Range**	6.71-19.42	1.70-9.74	8.41-29.16
	Mean	13.07±4.0	5.72±2.1	18.79±4.9
	CV	29.3	37.9	24.4
Epqt	**Range**	4.10-12.87	2.04-6.39	6.14-19.26
	Mean	8.49±3.1	4.22±1.3	12.70±4.0
	CV	28.6	27.1	24.9
Eott	**Range**	2.13-8.96	0.79-3.80	2.92-11.47
	Mean	5.55±1.9	2.29±0.7	7.20±2.1
	CV	34.9	41.9	29.3

Table 1: Bicarbonate extractable P forms in soils of great-groups recognized in Qena Governorate.

@ Vtt= Typic Haplotorrerts, Eftt= Typic Torrifluvents, Epqt= Typic Quartzipsamments, and Eott= Typic Torriorthents.

$ P_i= Olsen's extracted inorganic P ($NaHCO_3$-P_i), P_o = Olsen's extracted organic P ($NaHCO_3$-P_o), P_t = total Olsen's extracted P ($NaHCO_3$-P_t) # CV= Coefficient Variation

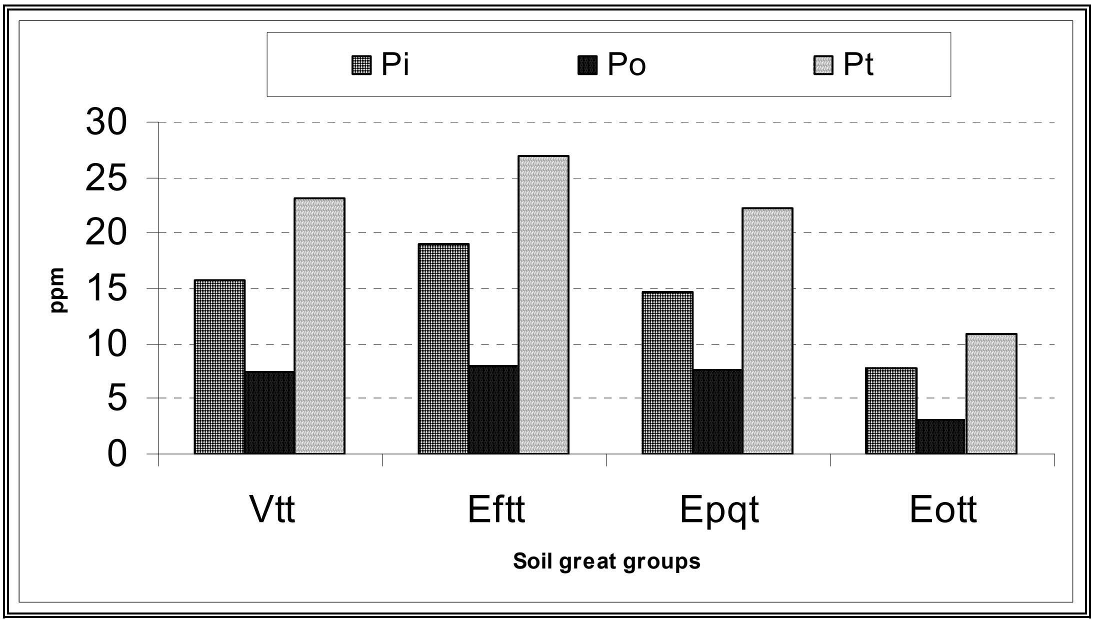

Fig. 2. Averages of bicarbonate extractable P forms in the surface layer (0.00-0.30 m) of soils of different great-groups located in Qena govenorate.

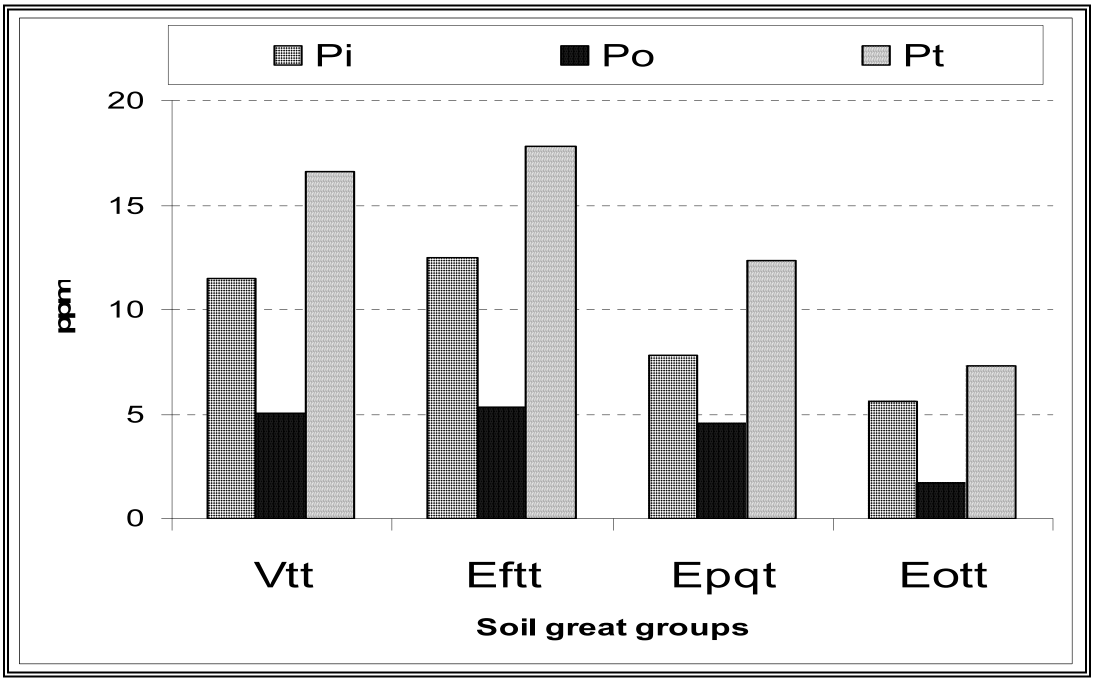

Fig. 3. Averages of bicarbonate extractable P forms in the sub-surface layer (0.30-0.60 m) of soils of different great-groups located in Qena governorate.

1- 2- Bicarbonate extractable organic P ($NaHCO_3$-P_o):

The bicarbonate extractable organic P ($NaHCO_3$-P_o) is mainly consisted of low molecular weigh organic compounds that associate P through the ester bond. This P form is water-soluble, stable, undissociated organic compounds, and protected from being precipitated or adsorbed on the surfaces of solid particles. This P form is readily available for plant uptake. The $NaHCO_3$-P_o contents in the studied soils were different between soils of great groups and among the soils of each great-group (Table 1). The amount of $NaHCO_3$-P_o in the surface layers of Vtt, Eftt, Epqt, and Eott great-groups ranged between 2.03- 11.64, 5.50- 11.16, 5.20- 9.24 and 1.19- 6.52 ppm, with an average of 6.8$\pm$2.3, 8.33$\pm$1.4, 7.22$\pm$1.3, and 3.86$\pm$1.26 ppm, respectively. In the sub-surface layers the amounts of $NaHCO_3$-P_o were relatively lower than that in the surface layers, and ranged between 1.74-9.70, 1.70-9.74, 2.04-6.39, and 0.79-3.80 ppm with an average of 5.72$\pm$2.1, 5.72$\pm$2.1, 4.22$\pm$1.3 and 2.29$\pm$0.7 ppm for Vtt, Eftt, Epqt, and Eott great-groups, respectively. The $NaHCO_3$-P_o content is generally corresponding with the organic matter content of the soil samples. Samples of the surface layers had particularly high $NaHCO_3$-P_o content than the subsurface layers. This could be explained on the bases that surface layers have higher amounts of organic matter. On the other hand, as organic-P tends to be adsorbed on the surface of clay particles, it would generally be excepted that soil layer with high amount of clay, as well as clayey soils possess high organic-P contents than soil layers with low clay content and sandy to loamy soils (Harrison, 1987).

1-3: Total phosphorus ($NaHCO_3$-P_t):

Values of total bicarbonate extractable phosphorus ($NaHCO_3$-P_t) are presented in Table (1). These data show a considerable variation in $NaHCO_3$-P_t among various soil samples. The $NaHCO_3$-P_t content of the studied soil samples in different soils of great-groups ranges between 12.17- 42.06 ppm, 15.21- 37.11 ppm, 14.67- 31.88 ppm, and 4.30- 23.28 ppm with an average of 27.1+7.0 ppm, 26.16+5.2 ppm, 23.28+4.6 ppm, and 11.66+3.00 ppm in the surface layer and between 7.36- 35.16 ppm, 8.40- 29.16 ppm, 6.14- 19.26 ppm and 2.92- 11.47 ppm with an average of 21.26+7.2 ppm, 18.79+4.9 ppm, 12.70+4.0 ppm and 7.20+2.1 ppm in the subsurface layers of Vtt, Eftt, Epqt, and Eott great groups, respectively.

The data indicated that $NaHCO_3$-P_t in soils generally decreased as the soils become coarse in texture, low in organic matter content, and high in total calcium carbonate content. Being heavy clay soils, the soils of Vtt great-group have the highest amounts of $NaHCO_3$-P_t, while the soils of Eott great-group which are mainly sandy soils with low amounts of organic matter, and high amounts of total calcium carbonate, have the lowest amount of $NaHCO_3$-P_t.

It was found that the high values of $NaHCO_3$-P_t are present in the surface layers and decreased with depth, this mainly might be due to the phosphate fertilizers addition. Data are in harmony to those obtained by (Mishra and Verma, 1979; Piccolo and Huluka, 1986; and Abd El-Galil and Ibrahim, 2001).

2: Relationships between bicarbonate extractable P forms and P uptake:

Relationships between bicarbonate extractable P forms and P uptake by Raygrass was studied using the standard procedure of New Power as described by (Abd El-Hamed, 1998; and Hammad *et al.*, 1998). is considered of great important to emphasize the role of each P forms in supplying the growing crops with their needs of P.

As shown in (Figure 4), P uptake in Raygrass was positively and significantly (P<0.05) correlated with both bicarbonate extractable P forms P_i and P_o, as well as the bicarbonate extractable total available P_t. The Pearson simple correlation coefficients for the P uptake against P_i, P_o and P_t are 0.78**, 0.78** and 0.82**, respectively. The similarity of correlation coefficients of P_i and P_o suggested that both P forms similarly contribute to supplying the plants with their needs of P.

The results of multiple regression analysis (Table 2) showed that P uptake was highly significantly (P<0.01) affected by both bicarbonate extractable inorganic (P_i) and organic (P_o) forms of soils, and both P forms were positively correlated with standard measured P uptake by Raygrass. Multiple regression equation (Table 3) with bicarbonate extractable inorganic-P (P_i) and organic-P (P_o) forms as independent-variables and the P uptake as dependent-variable showed that these two forms of extractable P explained 94.6 % (P<0.01) of the variations of the P uptake by Raygrass measured by the standard procedure, over all soils great-groups. Based on these results, P uptake by Raygrass grown in soils of great-groups recognized in Qena Governorate could be estimated using the bicarbonate extractable P_i and P_o from the following equation:

P uptake = -1.76 + 0.48P_i + 0.56 P_o

(*P* <0.01 and R^2 = 0.95)

This equation explains that, in soils of great-groups recognized in Qena Governorate, P uptake could be expected to increase with increasing the size of P_i and P_o pools extracted by Olsen's procedure. The data of multiple regression of P uptake as Y-dependent variable and Pi, Po, and labile P as X-independent variables was presented in Tables (4 and 5). It is quite clear that by including the amount of labile P in the multiple regression equation 95.6% in the variations in P uptake could be explained by the variations in Pi, Po and labile P. Based on these data, the amount of P that could have been taken up by plants grown in soils of great-groups could be estimated by using the following equation:

P uptake = -4.64789+0.38102 P_i + 0.039318 Po + 0.035236 Lab.P

(*p* < 0.01, R^2 = 0.96)

Effect	Sum of Squares	df	Mean Squares	F	p-level
Regress.	675836.6	2	337918.3	1813.9	0.000
Residual	38563.8	207	186.3		
Total	714400.4				

Table 2. Analysis of variance of dependant variable P uptake with independent variables P_i and P_o.

	BETA	St. Err. of BETA	B	St. Err. of B	t(207)	p-level
Intercept			-1.7562	3.503	-0.501	0.6167
P_i	0.4567	0.041006	0.48054	0.043	11.137	0.0000
P_O	0.5361	0.041006	0.56075	0.043	13.073	0.0000

Table 3. The estimated equation and coefficients relates P uptake with bicarbonate extractable P_i and P_o.

R= 0.97263527 R^2= 0.94601938 Adjusted R^2= 0.94549783
F(2,207)=1813.9 p<0.0000 Std. Error of estimate: 13.649

Variables currently in the Equation
Dependent Variable : P uptake
Independent Variables: Pi and Poe

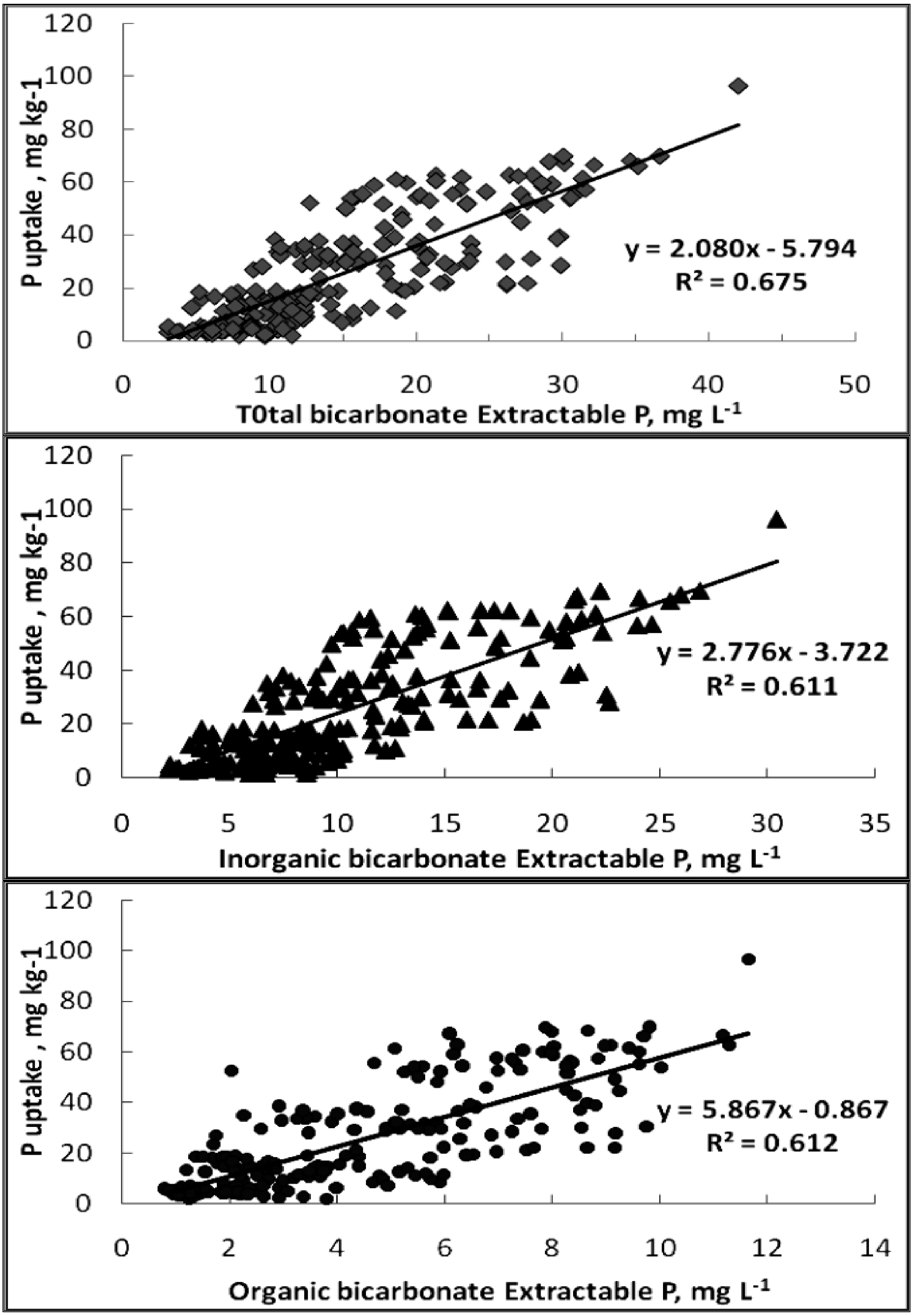

Fig. 4. Relationships between P uptake and different forms of bicarbonate extractable P in all soils of great groups.

Effect	Sums of Squares	df	Mean Squares	F	p-level
Regress.	685697.9	3	228566.0	1640.4	0.0000
Residual	28702.5	206	139.3		
Total	714400.4				

Table 4. Analysis of variance of dependant variable P uptake with independent variables P_i, P_o and labile P.

	BETA	St. Err. of BETA	B	St. Err. of B	t(206)	p-level
Intercept			-4.647	3.0496	-1.52408	0.129023
P_i	0.364253	0.040923	0.3810	0.042807	8.90092	0.000000
P_O	0.357622	0.037367	0.37630	0.039318	9.57061	0.000000
Labile P	0.290577	0.034540	0.29643	0.035236	8.41280	0.000000

Table 5. The estimated equation and coefficients relates P uptake with bicarbonate extractable P_i, P_o and labile P.

Regression Summary for Dependent Variable: P uptake

$R= 0.97970555$ $R^2= 0.95982297$ Adjusted $R^2= 0.95923786$

$F(3,206)=1640.4$ $p<0.0000$ Std. Error of estimate: 11.804

Variables currently in the Equation:

Dependent Variable: P uptake, and Independent Variables: Pi, Po and Labile P. It can be concluded that soils of Vtt and Eftt great-groups are considered to be rich in their phosphate contents, and Epqt great-group are considered to be medium in their phosphate contents, but in general Eott great-group soil are considered to be low in their phosphate contents, but the available forms are not enough to meet the demand of plant requirements. Therefore, to enhance soil phosphorus availability the more of research will be need to overcoming the problems of high pH values and the phosphorus sorption maximum in these soils.

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الملخص العربي

حالة الفوسفور في أراضي المجوعات العظمي بمحافظة قنا

حسين راغب[١] و كمال عطية[٢] ، علي عبد الجليل[٣] ، عبير عبد المعز[٤].
قسم الأراضي والمياه – كلية الزراعة – جامعة أسيوط.[١،٢]
قسم الأراضي والمياه – كلية الزراعة – جامعة سوهاج.[٣]
قسم الأراضي والمياه – كلية الزراعة – جامعة جنوب الوادي.[٤]

الملخص:

أجريت الدراسة الحالية بهدف دراسة حالة عنصر الفوسفور في أراضي المجموعات العظمي بمحافظة قنا أراضي محافظة قنا تتدرج تحت مجموعات الأراضي العظمي التالية Vtt, Eftt, Epqt, Eott . تم أخذ ١٠٥ عينة تربة تمثل كل مجموعات الأراضي العظمي الموجودة في نطاق محافظة قنا، قدرت صور الفوسفور المختلفة في أراضي المجموعات العظمي بمستخلصات كيميائية مختلفة . وأجريت تجربة أصص لمعرفة القوة الامدادية للأرض بالفوسفور بواسطة حشيشة الراي ، وأوضحت النتائج مايلي :-

- أن هناك اختلافا واسعاً في الفوسفور المستخلص بالبيكربونات ($NaCO_3$-P_i) في أراضي المجموعات العظمي المختلفة حيث تزيد قيم الفوسفور المعدني (P_i) في الطبقات السطحية وتقل بالعمق .
- و أن هناك اختلافا في محتوي الأراضي من الفوسفور العضوي المستخلص بالبيكربونات ($NaCO_3$-P_o) بين أراضي المجموعات المختلفة و أيضاً في الأراضي المجموعة الواحدة .
- فأن هناك اختلافا واضحاً بالنسبة لكمية الفوسفور الكلي المستخلص بالبيكربونات ($NaCO_3$-P_t) في عينات التربة المختلفة . والنتائج أيضاً توضح أن الفوسفور الكلي في الأراضي يقل عموماً في الأراضي خفيفة القوام القليلة في محتواها من المادة العضوية والعالية في محتواها في كربونات الكالسيوم .
- توجد علاقة ارتباط معنوية وموجبة بين الفوسفور الممتص بواسطة حشيشه الراي و صور الفوسفور المستخلص بالبيكربونات العضوي وغير العضوي وكذلك الفوسفور الكلي وهي (٠,٧٨١٧**، ٠,٧٨٢٣**، ٠,٨٢١٥** علي الترتيب) .