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POTASSIUM SUPPLYING POWER IN MARSHES SOILS AND SEDIMENTS

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SUMMARY

Potassium supplying power of representative marsh soils & sediments of south Iraq was, evaluated by chemical methods. Results indicate that soils are relatively more in all forms of potassium in comparison to the sediment samples. Generally, both of them have the relatively high content of potassium supplying power and could be enough for (10- 20) years of intensive cropping. These high amounts represented, however less than (15.605) and (13.705) of the total mineral potassium content of soils and sediments, respectively. On the basis of the woodruff scale, all the studied samples could be placed adequate-good category.

INTRODUCTION

The existence of potassium (k) in soils as a cationic species in addition to its being a constituent of layer silicates is well understood. Various from of soils potassium in arid & semiarid regions are generally contain large quantities (Prasad & Power,1997). the contribution of non-exchangeable K release has been studied over the last years . A great number of long term trials in the field and in the greenhouse have been carried out demonstrating that very substantial amounts of K can be released from non-exchangeable sources and plants are found to absorb high percentage of it (Mengel & Kirkby, 1982). This may be presumably due to the greater potassium uptake lowered the equilibrium concentration more, thus effecting a more pronounced disturbance of the equilibrium.

Many investigators such as Naji & Hussain (1972), AL-Mahammadi (1975); AL-Zubaidi & Pagel (1979) and Awad & AL-Tamimi (1990) suggested that almost of Iraqi soil contain high potassium (reserve) and such quantities of potassium in soils are enough for at least 10-20 years of intensive cropping .However, AL-Tamimi (1988) observed that some of calcareous soils which were collected from southern of Iraq and using in a pot experiment are responded to K fertilization .This could be due to the K fertilizers had been added over a long period and those soils were almost under cultivation annually.AL-Fargawi (2000)found that the coefficient rates of non-exchangeable (reserve) potassium release from Iraqi soils are relatively low. Until recently, information on K content and supplying power in respect of marsh soils in southern part of Iraq is not available. Therefore, the purpose of this study paper is to clearify the relationship between soils and sediments content that are collected from marsh regions and the nature and stability of K containing clay minerals.

MATERIALS AND METHODS

Nine marsh soils and other sediments samples were collected from different location of marsh region of the southern Iraq representing different area and these samples were collected from surface layer (0-0.3m), air–dried, and crushed to pass a(2 mm)sieve before analysis. Various chemical and physical properties of these samples have been described by page *et al* (1982) and Black (1965). These characteristics are given in Table 1&2.

Five grams of soil or sediment samples were placed in (250ml) polyethylene conical shaked and for (24hrs) with (100ml) deionizer water at (25c) pH was measured in the suspensions after the equilibrium time. Then the suspension, were filtered by whatman filter paper No.42. The clear solutions obtained were analyzed for electrical conductivity potassium, calcium and magnesium concentration.

Water soluble K was estimated in the extract soil paste (page *et al*, 1982) .Non-exchangeable K was extracted with boiling HNO3 (Pratt,1965) and the total K with HF digestion (Bukley & Gransto, 1971). The potassium in each of the extract was measured using flame photometer .Mineral K was estimated by substracting the sum of water, IN HNO3 -extractable K from total K (Martin & Sparks, 1983). Ion activities were computed using association constants for ion complexes (Lindsay, 1979) and the Davies (1962) equation for activity coefficient.

RESULTS AND DISCUSSION

Total K in the studied soil varied from (285) to (410) with the mean value of (333.222) mmol K^{+1}·Kg^{-1}soil. It was higher in marsh soil than in marsh sediments .this could be attributed to the presence of easily weatherable Mica and Illite of type of minerals bearing potassium.Acid soluble potassium represents the supplying power of potassium in soil for long term cropping (Jackson, 1958; AL-Zubaidi & Pagel, 1979). The values of this from of potassium in the studied soil samples varied from (37.30) to (81.00) mmol K^{+1} Kg^{-1} soil with the mean value of (52.00) mmol K^{+1} .Kg^{-1} soil (table 2) .Water soluble K varied from (0.58) to (0.98) mmol K.L^{-1} (Table 2) These values are in general higher than that in other alluvial soils of Floodplain soils (Awad & AL-Tamimi, 1989). Furthermore, these results may thus support the suggestion that the content of various K forms in the marsh saline soils of the southern Iraq were the highest in comparison to levels in other different location in the middle and northern Iraq (AL-Zubaidi & Pagel, 1974; 1979). This could either be due to the relatively high degree of weathering process or that salt accumulation in southern Iraq. It is also known that the high clay and organic matter contents of the studied soils (Table1) may play the significant role on increasing K content in soils. In general, these results are also similar to those found for same other soils of arid regions such as soils of Yeman and Sudan (Pagel, 1972) and Cyprus (Mutscher & Tschiattalos, 1977; Tschiattalos, 1972).

The values of water soluble and supplying power of potassium in the studied marsh sediments are lower than in the marsh soil samples other alluvial soils (Table 2). Values of total- K of potassium in the studied marsh sediments varied from (265) to (299) mmol K^{+1}.L^{-1} with the mean vale of (280.444) mmol K^{+1}.L^{-1}. While acid soluble potassium are ranged between (31.40) and (51.10) mmol K^{+1}.L^{-1} with the mean value of (38.434) mmol K^{+1}.L^{-1} K^{+1}.Kg^{-1}. This could be due to the lowest contents of organic matter and salanity (Table 1& 2).

If we consider the critical value for potassium efficiency in plant nutrition, which has been either proposed for other soils (= 1.03 mmol K^{+1}·Kg^{-1} soil; Pagel, 1972; Hami, 1974). Or suggested for southern Iraqi soils (= 1.80 K^{+1}.Kg^{-1}; Awad & AL-Tamimi; 1989). That means, all the studied soils and sediment more than (20) times of the critical level. In other words, the available K forms of potassium is equal about (290)Kg K^{+1}.ha^{-1} as a minimum & Kg K^{+1}.ha^{-1} as the mean content. Such quantity of available potassium in the studied soils and sediments is enough for at least (10-20) years of intensive cropping. Similar; results are reported by Al-Zahaidi & Pagel (1974) and Awad & AL-Tamimi (1989) and. However, it is necessary to consider possible less of available potassium during the leaching processes due to the high content of mobile forms of

K in salt affected soils. Therefore potassium fertilizer may have considerable value for such soils after reclamation.

The energy of replacement of K (ΔF) was calculated according to Woodruff & McIntosh (1960) as:-

$$-\Delta F = RT \ln AR_{\circ}^{k}$$

Where $AR_{\circ}^{k}$ is the equilibrium potassium activity ratio(= 2.303 RT log $a_k / \sqrt{a_{Ca} + a_{Mg}}$), a_k, a_{Ca} and a_{Mg} = activity of potassium, calcium and magnesium in soil extract ($mol.L^{-1}$) receptivity; R= gas constant and T=absolute temperature.

The exchange free energy (ΔF) in the soils (Table 3) varied between (-2610) to (-2950) $Cal.M^{-1}$ in soils and sediments, recpectivity. The higher values of free energy observed in all soils & sediments as companied that with other studies on Iraqi soils (Al-Alzubaidi & Bassam, 1992). Woodruff (1955) classified different soils in respect to thin ability for potassium supply to plant according to –ΔF values as follows: soils are poor (deficient in available k) in potassium supply have values (-4000)–(-3000) Cal/mol; soils with adequate potassium supply have –ΔF values (-3000)–(-2500) $Cal.mol^{-1}$and soils which are rich (caused potassium toxicity) in potassium have –ΔF values less than (-2000) $Cal.mol^{-1}$. that means, all soils and sediments have adequate good supply of potassium for cropping. Furthermore application of any amount of potassiun as fertilizer will cause a considerable change in –ΔF values to the range of rich potassium supply. Therefore, It could be colcuded that all the studied samples (soils & sediment). have enough potassium amounts and potassium view for such samples after reclamation.

REFERENCES

AL-Fargawi, M.S. (2002). Using kinetics and mathematical equations in evaluating and prediction the amount and rate of non-exchangeable potassiumeleasefrom, calcareous.M.Sc.Thesis University of Basrah-Iraq.

AL-Mohammadi, Nuri Hamdan (1975). Potassium supplying power of some Iraq soils as related to their chemical and mineralogical properties M.S. thesis, College of . Agriculture, University of Baghdad.

AL-Zubaidi, A.H. and Pagel, H. (1974). Chemical characteristics of some Iraqi soils Tropische Lardwirtschaft and Veterinarmedizin, 12:229-320u.

AL-Zubaidi, A.H. and Pagel, H. (1979). Content of different potassium forms in some Iraqi soils. Iraqi. Agric.Sci.14:214-239.

AL-Zubaidi, A.H. and EL-Bassam, N.(1992).Rapid measurement of potassium activity and energy in soil.Iraqi J.Agri.Sci.23(2).

AL-Tamimi, H.J. (1988). Fertility evaluation of potassium content in southern Iraq soils and corn response to organic and potash fertilizing .M.Sc.thesis.College of Agriculture University of Basrah

Awad, K.M. and H.j.H. Al-Tamimi. (1989). an evaluation of potassium availability indices of some soils of south Iraq. I:-Use of chemical extractants. Basrah J.Agric. . Sci., 2 (1&2).

Awad,K. M.and H. j. H. Al-Tamimi. (1990).An evolution of potassium availability indices of some soils of south Iraq. II:-Quantity-Intensity relationships and the energy of replacement. Basrah J. Agric. Sci., 3(1&2).

Black, C.A. (1965). Methods of soil analysis physical properties. Amer. Soc. Agro. Inc. .. Publisher, Madison, Wisconsin USA.

Buckley, D. E. and Cranston, R.E. 1974. Atomic absorption analysis of 18 elements from single decomposition aluminosilicate. Chem. Geol., 7:273.

Davies, C.W.(1962).Ion association.Butter Worths,London.

Hami, O.(1974). Allegeneine Characterized rung,Phosphate-und Kaiumhaushalt verschiedener Boden Marokkos. Desertion, KarI-Marx- Universitat.

Jackson, M. L. (1958).Soil chemical analysis. Prentice-Hall Inc Englewood, Cliffs, N.J. Martin, H.W. and D.L. Sparks (1983). Kinetics of non-exchangeable potassium release from two coastal plain soils. Soil Sci. Soc. Am. j. 47:883-887.

Mengel, K. and E.A. Kirk by (1982). Principles of plant nutrition international potash . institute Bern, Switzerland.

Mutoscher, H. and Tschiattalos, Chr. (1972). UN tersuchungen sum Einnflus der Natriumversalzung auf den K-Haushalt der Boden arider Gebiet. I: Mitteilung Material, Verhaltnsse zwischen vershiedenen k-Formen. Beitr. tropische landwirtschaft and Veteinarmedizin, KUM. H.3:191-209.

Naji, T. and Hussian, Dhia. (1972). Soil release potassium relation to potassium potential in filtrates of successively extracted samples of cropped fertilized fudhailya silty . .. clay. 1st Congr. Of the Scientific Res. Foundation, Baghdad.

Page, A.L., R.H. Miller and D.R. Kenney (1982). Methods of soil analysis. Part (2), 2nd. ed. Agronomy 9.

Pagel H. (1972). Vergleichende Untersuchungen uber den Gehalt an austauschbarem and nachlieferbaren Kalium in wichtigen Boden der ariden and humiden Tropen. Beitr. tropische and subtropische Landwirtschaft and Tropenvert-inarmedizin, KMU, Leipizig, 10: 35-51.

Pratt, P.F. 1965. Potassium. In Black, C.A. (Ed.). Methods of soil analysis. Agronomy 9:1022-1030. Am. Soc. Agrn. Madison.

Prasad, R. and J.F. Power (1997). Soil fertility management for sustainable Agriculture. Lewis publishers, New York. P: 211-228.

Tschiattalos, Chr. (1972). Einfluss steigender sodium salzkonzen trationen and P flonzen wachstum and Kationenhaushalt zweier typischer Boden Zyperns. Dissertation, Karl-Marx-Universidad Leipzig.

Woodruff, C.M. (1955). Ionic equilibrium between clay and diutte salt solution. Soil SCi. Soc. Am. Proc., 19: 36-40.

Woodruff, C.M. and j.L. McIntosh. (1960). Quantity–Intensity relationships of potassium in soils. Trans. 7th Int.Congr Soil Sic., 3:80.

Lindsay, W.L. (1979). Chemical equilibrium in soils. John Wiley and Sons. Inc. New York.

مجلة البصرة للعلوم الزراعية ، المجلد ١٩ ، العدد ٢ ، ٢٠٠٦

قدرة تجهيز البوتاسيوم في ترب ورواسب الاهوار

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الخلاصة

تم دراسة قدرة تجهيز آيون البوتاسيوم في ترب ورواسب الاهوار وبطرق كيميائية مختلفة. حيث اشارت النتائج الى ان الترب المدروسة تحتوي نسبياً على صور البوتاسيوم اكثر من الرواسب. وعموما فان كلاهما يحتويان على قدره عاليه من تجهيز البوتاسيوم وهذه قد تكفي لفتره زراعه مكثفه تصل الى (١٠-٢٠) سنة.والكميه العاليه تمثل من ناحيه اخرى نسب اقل من(١٥.٦٠٥) و(١٣.٧٠٥) من المحتوى الكلي من البوتاسيوم .ووفقا لمقياس Woodruffجميع العينات المدروسه يمكن وصفها بانها في حيز الكفايه الجيد من خلال تجهيز البوتاسيوم.

Table (1) Selected Chemical and Physical Properties of the Studied Soils and Sediments.

	Samples No.	pH 1:1	E.C. dS m^{-1}	Caco3 gm kg^{-1}	O.M. gm kg^{-1}	Texture Classes
Soils	1	٧.٧٤	١٩.٤٠	٤١١	٢٣.٤٠	Silty clay
	٢	٧.٥٢	٩.٢٠	٣٩٣	١٧.٤٠	clay
	٣	٧.٦٧	٤٠.٢٠	٣٧١	١٨.٢٠	clay
	٤	٧.٤٤	٢٠.٤٠	٢٩٤	٢٤.١٠	clay
	٥	٧.٢٤	٣٢.٩٠	٢٩١	١٧.٤٠	Silty clay

	٦	٧.٦٧	٢٢.٢٠	٣٥٤	١٧.٤٠	Silty clay
	٧	٧.٦٢	٩.٤٠	٣٦٧	٢٢.٤٠	Silty cl
	٨	٧.٤٤	٤٥.٥٠	٣٩٤	٢٢.٣٠	clay
	٩	٦.٩١	١٣.٤٠	٣٤٢	٢٦.٤٠	clay
Sediments	١	٦.٧٢	١٥.٢٠	٢٥١	٢٠.٢١	Silty clay
	٢	٦.٤١	٨.٦٠	٣٩٠	١٤.٣٢	clay
	٣	٦.٧٥	٢٤.٢٠	٢٩٧	١٤.٢١	clay
	٤	٦.٧٢.	١٥.١٠	٢٨١	٢١.٢١	clay
	٥	٥.٤٣	١٩.٢	٢٧٢	١٤.٢١	Silty clay
	٦	٦.٦٦	٢٠.٢٠	٢٥٢	١٣.٤١	Silty clay
	٧	٥.٣٢	٤.٥٠	٢٦٢	٢٠.٣٤	Silty clay
	٨	٥.٤١	٢٢.٢٠	٢٧١	١٨.٣٥	clay
	٩	٥.٣٤	١٢.٤٠	٢٣٤	٢١.٤١	clay

Table (2) Forms of Potassium in the Studied Samples

	Samples No.	Water Soluble Mmol . L^{-1}	Non-exch-K+ Mmol .Kg^{-1}	Total-K Mmol .Kg^{-1}	Mineral-K
Soils	1	٠.٥٨	٤٨.٥٠	٢٩٩	٢٥٠.٥٠
	٢	٠.٦٣	٣٧.٣٠	٣١٠	٢٧٢.٧٠
	٣	٠.٦١	٣٨.٥١	٣٤٠	٣٠١.٤٩
	٤	٠.٦٩	٣٨.٣٤	٢٨٥	٢٤٦.٦٦
	٥	٠.٦٩	٤١.٣٢	٢٩٥	٢٥٣.٦٨
	٦	٠.٦٧	٦٨.٤٣	٣٦٠	٢٩١.٥٧
	٧	٠.٦٧	٦٨.٤٥	٣٤٠	٢٧١.٥٥

	٨	٠.٧٣	٨١.٠٠	٤١٠	٣٢٩.٠٠
	٩	٠.٩٨	٤٦.١٥	٣٦٠	٣١٣.٨٥
Sediments	١	٠.٥١	٣٣.٦٠	٢٧٥	٢٤١.٤٠
	٢	٠.٥٥	٣١.٤٠	٢٨٠	٢٤٨.٦٠
	٣	٠.٥٣	٣٢.٦٠	٢٨٥	٢٥٢.٤٠
	٤	٠.٥٥	٣٤.١١	٢٨٠	٢٤٥.٨٩
	٥	٠.٥٢	٣٦.٨٠	٢٦٥	٢٢٨.٢٠
	٦	٠.٥٠	٤٢.٤٠	٢٧٥	٢٣٢.٦٠
	٧	٠.٤٣	٤٢.٤٠	٢٨٠	٢٣٧.٦٠
	٨	٠.٤٢	٥١.١٠	٢٩٩	٢٤٧.٩٠
	٩	٠.٥٤	٤١.٥٠	٢٨٥	٢٤٣.٥٠

Table (3) Potassium and (-Δk) values in the studied samples

	Samples No.	I (Mol. L^{-1})	K+ (Mol. L^{-1})	-ΔF (Cal. Mol. L^{-1})
Soils	**1**	٠.252	٠.290	2880
	٢	0.120	0.151	2810
	٣	0.523	0.439	٢٦٦٠
	٤	0.265	0.448	٢٦١٠
	٥	0.428	0.428	٢٧٤٠
	٦	0.289	0.462	٢٦٢٠
	٧	0.120	0.281	٢٩٥٠
	٨	0.592	0.496	٢٦١٥

	٩	0.172	٠.706	٢٦٠٠
Sediments	١	٠.198	٠.٢٥٠	٢٩٩٥
	٢	٠.112	٠.٢٣١	٢٩٩٠
	٣	0.315	٠.٣٢٩	٢٨٩٠
	٤	٠.196	٠.٢٧٣	٢٨٩٠
	٥	٠.250	٠.٣٣٨	٢٩٣٠
	٦	0.263	٠.٢٨٠	٢٩٥٠
	٧	0.188	٠.٢٠٦	٢٩٥٥
	٨	٠.٢٨٩	٠.٢٨٦	٢٨٩٠
	٩	٠.١٦١	٠.٢٤٨	٢٩١٠