Egypt. J. Agric. Res. , 78 (2), 2000

A COMPARATIVE STUDY BETWEEN ELECTROULTRA FILTERATION AND SOME CONVENTIONAL EXTRACTION PROCEDURES OF SOIL-K ON SOME SOILS OF EGYPT

M. A. EL-AKABAWY AND F. M. MORSI

1 Soils, water and Environment Res. Inst., Agric. Res. Center, Giza, Egypt.

2 Central Laboratory of Design and Statistical Analysis. Agric Res. Center, Giza, Egypt.

(Manuscript received 27 July 1999)

ABSTRACT

Nineteen cultivated soil samples representing alluvial and nonalluvial soils differing in clay and K content, were tested for K using the most conventional K-extraction procedures, namely: water soluble-K, ammonium acetate, nitric acid and Q/I measurements. The results were compared and statistically correlated with the EUF-K parameters desorbed from the soil samples. The relative yield of the actually uptake-K from those soils by clover plants in a pot experiment was measured, as a biological index, to evaluate the validity of both the EUF and the other methods in describing K status. The EUF-K parameters showed correlation with the most important conventional K extraction methods. The biological test revealed that EUF-K parametrs are highly effective in describing soil-K status, comparing with the other used methods. The results ascertained the suitability of the EUF method in order to easily characterizing the K availability status, providing information on K mobility that cannot be obtained by the "static" conventional methods and for saving time and reagents.

INTRODUCTION

Many empirical soil analysis methods have been employed over the years in attempts to obtain suitable indices of potassium availability in soils. They include widely different types of extracting solutions such as pure or carbonated water, organic or inorganic solutions of weak and strong acids, neutral salt solutions and various buffer solutions. The desire for a less empirical foundation of soil analysis has led experts to specify the parameters, which must be considered in defining potassium availability in soils. This entails intensity, quantity and rate parameters. These parameters, however, can diverge widely in different soils depending on numerous soil properties.

Nemeth (1979) proposed the Electro-Ultra Filtration (EUF) method for evaluating the availability of plant nutrients in soils. In recent years, this method has been the has been gaining recognition by soil chemists in many countries and has been the subject of some International symposia (Bundonno *et al.*, 1988).

EUF a combination of electrodyalysis and ultrafiltration has been suggested as a useful method in soil fertility work to characterize the desorption parameters of soil nutrients. It works in principle for extraction of nutrient ions from soils under the influence of external electric field (Nemeth 1979, 1980, 1982). Many authors believe that this method provides means of assessing the potassium availability in soils more comprehensively and could be adopted as a tool for wide spread application (Simonis and Nemeth, 1985). Under Egyptian conditions, Shehata (1981), Shehata *et al.* (1984, 1985, 1986) reported that K extracted by EUF might be a better indicator for K status and K uptake by alfalfa plants.

It is understtandable that analysts must be careful not to accept an analytical method for assessing soil nutrients availability without adequate comparsion of this method with the official methods and calibration with plant uptake in experimental check studies.

The aim of this work is to assess the suitability of the EUF method for characterizing the K fractions of some soils of Egypt and comparing the results with those obtained from the most conventional methods that are in wide use, as well as calibrating all the tested parameters with plant K-uptake in a pot experiment. Correlation coefficients between these parame.ers and between plant K-uptake and each parameter were statistically analyzed.

MATERIALS AND METHODS

Nineteen cultivated soil samples (0-30 cm) were collected, handled and prepared for study and analysis. These samples were taken from different sites of Egypt to represent both those locally formed therein (termed as nonalluvial soils) and the alluvial soils of the Nile Valley. Table (1) gives some characteristics of the soils employed.

Official methods outlined by Jackson (1958), and Black (1965) were applied, unless any other methods have been mentioned. Potassium parameters studied were:-

1- Water soluble K in the soil paste (W.S.K).

2. Exchangeable - K (K_{ex}) by ammonium acetate.

3. Non-exchangeable K (K_n) was determined after Haylock (1956).

Table1. General characteristics of the tested soils.

Soil No.	Location	Coarse sand %	Fine sand %	Silt %	Clay %	Texture*	O.M. %	Ca CO_3
		Alluvial Soils						
1	El-Badrashin	45.5	27.4	8.5	18.6	S.C. Loam	1.8	3.3
2	Beni swif	24.8	20.1	16.2	38.9	S.C. Loam	2.6	2.3
3	Tanta	11.3	22.1	22.2	44.4	Clay	2.4	4.5
4	El-Kanater	13.3	17.8	23.9	45.0	Clay	2.7	2.0
5	Ashmoon	40.5	16.5	18.4	24.6	S.C. Loam	2.6	3.6
6	Esna	12.8	19.9	33.8	33.5	S.C. Loam	1.7	2.4
7	Itai EL-barod.	25.2	22.2	19.7	32.9	S.C. Loam	2.8	5.0
8	Belkas	24.9	23.7	14.9	36.5	S.C.	2.6	3.5
		Non - Alluvial Soils						
9	Qum-Osheem	25.7	46.5	12.8	15.0	S.Loam	2.4	9.7
10	N. Tahreer	41.5	31.5	13.7	13.3	S.Loam	2.3	31.8
11	Behira	70.0	22.3	2.6	5.1	S.	0.5	10.0
12	Salhia	69.8	7.5	10.5	12.2	L.Sand	1.8	7.5
13	EL-Shabab	75.5	9.2	4.1	11.2	L.Sand	1.4	1.9
14	Abo-Souere	70.9	13.7	4.9	10.5	L.Sand	0.7	0.2
15	Ismalia	86.3	9.4	2.2	2.1	Sand	0.4	0.7
16	East-Canal	94.1	1.9	1.8	2.2	Sand	0.3	0.4
17	Sharkia	88.5	1.5	3.1	6.9	Sand	1.1	2.5
18	Abohamad	79.5	1.7	10.0	8.8	L.Sand	1.4	4.3
19	Nobaria	38.0	26.7	12.7	22.6	S.C.Loam	1.3	35.5

* S = Sandy L = loamy C = clay

4. Potassium Intensity and Potential Buffering Capacity PBC. The Q/I relationship of K was determined using Beckett's procedure and its modifications (Beckett, 1987).

5. EUF-K parameters using fully automatic EUF equipment, according to the standard procedure proposed by Nemeth (1979 and 1980). Simply, the EUF method is a combination of electrodialysis and ultrafiltration, through which the desorption and solubility rates of plant nutrients can be determined in a single extraction run, without determination of the various soil properties, which certainly govern the status of any nutrient (or element) in the soil. Seven EUF extracts were obtained at 5 min. intervals through 30 minutes at 20°C then it was raised automatically to 80°C at the last 5 min. The voltage was changed as follows: 0-5 min. 50 V.; 5-30 min., 200 V., and 30-35 min., 400 V.

The pot experiment:

For each soil sample 8 earthenware pots received 3.5 Kg soil/pot, and both of nitrogen and phosphorus at the rate of 45 Kg N and 30 Kg P_2O_5/fed.

Two treatments were raised (4 replicates) in complete randomized block design, namely:- (1) (+K-or Control) and (2) (-K). The first treatment received K at the rate of 50 Kg K_2O/fed. A fixed quantity (0.1 g) of clover seeds (previously inoculated with specific Rhyzobia) was uniformly planted, then the soils were kept at 60% of its water holding capacity. After 50 days plants were cut above soil surface, while the second cut was obtained after the following 30 days. The aerial parts were dried at 70°C, weighed, ground and wet ashed for K determination by flame photometer.

RESULTS AND DISCUSSION

The investigated soil samples vary greatly in their physical and chemical properties (Table 1 and 2).

Exchangeable potassium (K_{ex}) values ranged between 0.66 and 1.85 me K/100 g for alluvial soils with a mean value of 1.24 me K/100g soil, while lower limits are shown for the non-alluvial soils (0.12 to 1.17 me/100g soil) with a mean value of 0.53 me/100g soil. Table (4) shows correlations matrix between various K parameters. A significant linear correlation coefficient was found between K_{ex} values and soil clay content (r = 0.72**).

As to potassium saturation percent (K/C.E.C.) values (Table 2), it ranged between 2.48 and 15.6. These percent values were positively correlated with water solu-

Table 2. Exchangeable potassium, C.E.C, non-exchamgable potassium (K_n), percent of K-Saturation (K/C.E.C.) and Q/I parameters.

Soil No.	Exch - K	C.E.C.	K_n	K/ C.E.C.%	Q/I parameters		
	me/100 g soil				$-\Delta K$	AR_K	PBC
	Alluvial Soils						
1	0.98	21.3	1.38	4.60	0.75	1.05	71.4
2	1.41	23.0	2.51	4.40	1.65	1.35	122.2
3	1.27	42.0	1.61	3.02	1.25	0.93	151.0
4	1.40	40.2	1.92	3.48	1.30	0.85	153.0
5	1.85	29.9	2.25	6.18	0.80	1.00	73.0
6	0.66	26.6	0.89	2.48	1.60	1.32	120.0
7	0.79	26.3	0.92	3.00	1.55	1.30	135.0
8	1.52	44.7	1.51	3.38	1.61	1.29	129.0
X	1. 235	32.88	1.62	3.82	1.31	1.14	119.3
	Non - Alluvial Soils						
9	0.77	19.5	0.82	3.95	0.20	1.50	16.3
10	0.50	12.4	0.49	4.03	0.30	0.67	45.1
11	0.38	6.8	0.48	5.58	0.22	1.68	13.0
12	1.11	10.5	1.39	10.57	0.30	1.42	22.1
13	1.17	7.5	1.83	15.60	0.15	0.98	18.1
14	0.40	9.8	0.70	4.09	0.30	1.50	20.1
15	0.12	4.2	0.30	2.85	0.07	0.80	8.70
16	0.12	3.8	0.35	3.16	0.07	0.85	7.60
17	0.19	5.8	0.33	3.28	0.12	0.66	18.2
18	0.27	7.0	0.51	3.86	0.14	0.69	20.2
19	0.79	17.0	0.86	4.65	0.44	1.50	29.3
X	0.529	9.48	0.73	5.60	0.21	1.11	19.9

ble potassium (W.S.K.) at 5% level (r = 0.46). The r value proved higher (r = 0.56**) with the non-alluvial soils. Similar results were reported by Abou El-Roos (1972) and El-Akabawy (1991) on some soils of Egypt.

Data of non-exchangeable-K (Table 2) show that K-extracted amount with 0.1 N nitric acid solution (K_n) have higher values than K_{ex} values which make most of this fraction. Hence, the amounts of K_n have almost the same trend of K_{ex} with correlation coefficient value of (r=0.94**). Similar of K_{ex}values, K_n values correlated with clay content significantly (r = 0.68**), and the finer the soil texture was, the higher were the K_n and K_{ex} values. In this respect, Moss and Coulter (1964) referred to K_n values as exchangeable-K.

The data obtained from the Q/I parameters, listed in Table (2), reveal that the equilibrium activity ratio (AR_{Ko} as $(M/L)^{1/2} \times 10^{-2}$). values are in the range between 0.66 and 1.68 for the non-alluvial soils and between 0.85 and 1.35 for the alluvial soils, with mean values 1.14 and 1.11 for the two soil groups respectively. The AR_{Ko} values are correlaated with the degree of saturation percent (K/C.E.C.) (r = 0.56**). This phenomenon was reported by Moss (1963) who affirmed that the parameters AR_{Ko} is dependent on the K saturation and strength of adsorption of cations. Similar results were obtained on Egyptian soils (Lasheen 1971, and Abd El-Hamid, 1983). The $-\Delta K^o$ Values ranged between 0.07 and 0.44 in the locally formed soils and between 0.75 and 1.65 me/100 g in the alluvial soils, with mean values of 0.21 and 1.31, respectively. The $-\Delta K^o$ Values were closely correlated with the levels of K_{ex} (r = 0.63**) as well as K_n (r=0.58**). They also were significantly correlated with clay soil content. Such results are in good harmony with those obtained by Abou El-Roos (1972). The potential buffering capacity (PBC), $(-\Delta K/AR_{ko})$ Values were highly correlated with clay content (r = 0.94**). Furthermore, it correlated with K_{ex} (0.62**). These correlations were in agreememt with the findings obtained on Egyptian soils by Abo El-Roos (1972) and El-Akabawy (1991). Thus, both the PBC and K_{ex} parameters are dependent of clay content ascertaining the close relation between each of PBC and K_{ex}. Grimme and Nemeth (1978) stated that PBC and K_{ex} values are dependent of clay content. Finally, exchangeable-K is the most important conventional parameter. However, it is a measure of the quantity which can be relatively easily mobilized as compared to the non-exchangeable K. But no information is obtained as to the rate at which it is mobilized, thus no true evaluation of availability can be made. However, for a plant, it is not so much the quantity present, which counts, but the rate at which the required quantity is supplied.

To our $K_n$owledge, the EUF method of soil analysis is the only method in practical use which takes dynamic aspects of nutrient supply into account. It allows the determination of intensity, quantity and buffering parameters as reported by Nemeth

(1979). It also allows an assessment of the change of mobile soil - K with time.

EUF-K parameters

Data of the EUF-K approach are given in Table (3) and graphs of interpretation of the mean data are given for the two soil groups in Fig (1).

According to Nemeth (1976), K-release (mg/100g soil/5 min.), reading the graph will be as follows:-

a) K-amount desorbed in the first 10 minutes will represent "K - intensity value "(K_{10}) in the test.

b) K-amount released over the 35 minutes will indicate " K-Quantity value" (K_{0-35}).

c) CD (on the curve) will represent the amount of K over the period 30-35 minutes under the rise of temperature from 20 ^{o}C to 80^{o}C and voltage up to 400 V; this value is termed "the supply rate" (K_{30-35}). If this section is lacking, then soil cannot buffer the decrease in concentration brought about by plant uptake.

d) AB/CD, represents the fixing index of the soil (F1).

a) The intensity EUF parameter (K_{10}):

K-mean quanties obtained within the first 10 minutes at 20^{o}C are somewhat alike in the two soil groups. This fraction corresponds roughly to those extracted with water (Simonis and Nemeth, 1985).

Actually, the K_{10} amounts are closely related with AR_{Ko} values (r = 0.7**) and less correlated with W.S.K (r = 0.45*). It is interesting to note that the highest correlaation between K_{10} and the other soil parameter was that with the K/C.E.C. (r = 0.9**). In this respect, Nemeth (1979) used the K_{10} value as an empirical measure of soil K- intensity. Nemeth (1982) concluded that, the higher the first peak (K_{10}) is, the higher is the K saturation percent, and less K will be fixed in the soil. However, it was concluded by Sinclair (1982) that K_{10} cannot be a true intensity measurement because it depends on soil-K buffering capacity.

Table 3. EUF-K parameters for the tested soils.

Soil No.	Intensity - K EUF-K K_{10}	Q/I parameters		Supply rate K_{30-35}	Fixation Index F.I.	KQ
		K_{0-30}	K_{0-35}			
		mg K/100 g				
		Alluvial Soils				
1	6.1	16.3	33.5	17.2	0.20	1.06
2	5.1	18.1	37.0	18.9	0.11	1.04
3	5.5	15.9	31.0	15.1	0.20	0.95
4	4.2	17.1	40.2	23.1	0.095	1.35
5	7.1	20.6	54.1	33.5	0.11	1.63
6	2.9	9.9	20.1	10.2	0.16	1.03
7	1.7	6.1	22.3	16.2	0.06	2.66
8	3.9	16.1	34.4	18.3	0.10	1.14
Mean	4.56	15.0	34.1	19.1	0.13	1.36
		Non - Alluvial Soils				
9	6.2	16.2	26.4	10.2	0.31	0.63
10	2.3	7.6	12.3	4.7	0.29	0.62
11	5.2	11.3	16.2	4.9	0.49	0.43
12	8.2	22.1	38.9	16.8	0.30	0.76
13	13.5	34.0	54.1	20.1	0.28	0.59
14	6.1	17.0	22.2	5.2	0.75	0.31
15	1.8	5.6	7.4	1.8	0.41	0.32
16	1.6	5.6	6.2	0.6	1.35	0.11
17	2.9	7.7	11.8	4.1	0.30	0.53
18	3.5	8.6	13.1	4.5	0.32	0.52
19	4.5	12.8	23.1	10.3	0.19	0.80
Mean	5.1	13.5	21.1	7.56	0.45	0.51

b) Capacity EUF parameter:

K_{0-35} has been considered to be a quantity parameter related to exchangeable-K (Nemeth, 1976, and Sinclair, 1982). This parameter shows a very high significant correlation with K_{ex} (r = 0.91**) and with K_n values (r = 0.9**).

The total EUF-K values (K_{0-35}) are actually very near to K_{ex} values, specially in the Sandy soils, and shows the same trend of K_{ex} in the alluvial soils. For example, Sandy soil samples number 15 and 16 show the lowest K_{ex} as well as the lowest K_{0-35} values, while soil number 13 shows the highest values in both K parameters (Tables 2 and 3)

c) K-EUF supply rate (K_{30-35}):

Nemeth (1976) believes that this fraction is a good measure of the supply rate of the soil, i.e. K-buffering. The K_{30-35} fraction correlates highly with each of K_{ex} (r= 0.95**), K_n (r=0.9**) and PBC (r=0.56**). In this respect, Sinclair (1982) was able to relate this (K_{30-35}) fraction with the release of initially non-exchangeable K in close equilibrium with the exchangeable pool. In Fig (1) it is clearly shown that at the last 5 min at 400 V an abrupt increase in desorption curve occurs particularly in case of alluvial soils, of higher buffering capacity. Data of Table (3) reveal that in alluvial soils K_{30-35} mean value represents more than 56% of the (K_{0-35}) total desporption through 35 minutes while this percent do not exceed 35.5 in case of non-alluvial soils. This result demonstrates that alluvial soils have higher K-supply rate ability.

d) EUF fixation Index (F.I):

This index is calculated by dividing the AB (first peak) over the second peak (CD). [F. I. = $(K_{5-10})/(K_{30-35})$]

According to Nemeth (1976), the higher this value is, the less will be the power of K fixation in soil, and vice versa. Table (3) affirms this statement, since higher F. I. values were obtained by the soil of less clay content, while lower F.I. were shown by the more heavy textured soils (higher clay content). Thus, the clay content correlates negatively with alluvial soils (0.13) and higher with non-alluvial soil group (0.45), indicating more K-fixation power with the former soil group. These results are in accordance with those obtained by Shehata *et al.*, (1985).

E- The EUF potential Buffer Index (KQ):

An important parameter of recent EUF research, with regard to potassium, is the use of the [$KQ = (EUF\text{-}K_{80^oC})/(EUF\text{-}K_{20^oC})$] quotient which characterizes whether or not the K ions are bound to planar or to K-selective sorption sites of the minerals. Simonis and Nemeth (1985) proposed this parameter and suggested a limiting value of 0.6 to differentiate between tightly adsorbed K on special sites (more than the 0.6 value) and loosely adsorbed K on planar and broken edges sites (less than 0.6). According to Simonis and Nemeth (1985) suggestions, one can postulate that a pronounced percent of K adsorbed in the light-textured soils (which, actually here, have KQ mean value around 0.51) belongs to the planar and broken edges type of sites while the selective adsorption of K predominates in the alluvial soils (of KQ mean value 1.36), which have higher K buffering capacity the whole growing season.

The former result can mean that the more the KQ ratio is, the more is the reserve-K in the sample regardless of its clay content. Actually, KQ correlated with Δ K and PBC significantly (r values = 0.72** and 0.69**, respectively), thus it can express well soil K buffering capacity.

k) k-Biological Index:

One would expect plants to be efficient in measuring available K. In fact, field trails are always needed to calibrate chemical methods, but for the purpose of extension services they are far too cumbersome and less precise. So, tests with small soil samples are more available to be employed. The relative yield of the actually K uptake of clover plants (mean of the two successive cuts) was used as a biological index to evaluate the validity of the EUF and other methods in describing K status.

$$\text{The relative K-uptake} = \frac{\text{K-uptake of the (-k) treatment.}}{\text{K-uptake of control treatment. (+ k)}}$$

Table 4 shows correlation values between K-parameters and the relative K- uptake. Hence, the most efficient K parameters could be arranged in the following decreasing order: EUF $K_{0\text{-}35} > K_{ex} > K_n > K_{0\text{-}30} > K_{30\text{-}35} >$ F.I. $>$ PBC $> -\Delta K$. Thus, the EUF quantity parameter$K_{0\text{-}35}$ showed the highest of all correlation values (r = 0.76**) with the relative K-uptake. However, all the rest EUF parmeters have been correlated with the relative K-uptake significantly. Thus, $K_{0\text{-}30}$ which mostly synonymous to readily available K, gave correlation coefficient of (r = 0.71**), while $K_{30\text{-}35}$ fraction expressing supply rate or the less readily available K, has r value of 0.69**. The last $K_{30\text{-}35}$ fraction is highly related with (K_n).

Correlations between K_{30-35} and non-exchangeable K have been obtained and discussed by Nemeth (1976), Shehata (1981) and Shehata *et al.* (1984). Shehata *et al.*, (1985) concluded that K_{30-35} (of Egyptian soils) has been related to the release of initially non-exchangeable K in close equilibrium with the exchangeable pool.

Later, Shekata *et al.* (1986) confirmed the importance of the various EUF-K fractions and found significant correlations between EUF-K and K availability by different chemicaal methods.

CONCLUSION

In conclusion, the achieved results allows to ascertain:- (1) the effectiveness of EUF for extracting different forms and fractions of potassium from soils, saving time and reagants in comparison with conventional methods. (2) the suitability of EUF in order to easily characterize the K availability status; proving information on K mobility that cannot be obtained by the static conventional methods. The greatest advantage of the EUF procedure is not only that close correlations can be worked out between K uptake and both the contents and quotients of EUF, but also that information can be obtained on the availability of other nutrients by analysis of one soil sample through an extraction run. Moreover, it can be observed that nutrient extraction by (EUF) method is very similar to the processes of nutrient supply to the roots that actually take place in the soil. The technique is thus more universal in application than the conventional chemical methods. It is suitable for different types of soils, where the nutrient status and fertilizer requirements can be only partly determined by the usual rapid methods. Similar conclusions were reported by Nemeth (1980 and 1982), Shehata et al., (1984). The technique appears to supply much scientific information about soil-K status concerning intensity, capacity, supply rate, fixation index, and the potential buffer index indicating the forces and sites by which K is bonded on the fine soil particles.

Thus by one extraction run, a good picture about K status in a soil sample could be obtained, how much K is readly available, and how much K could be desrobed through plant growth period becoming available as a reserve against depletion, and at last the rate by which that reserve K becomes more and more available.

Table 4. Linear correlation coefficients between the EUF-K parameters and the most important conventional-K parameters as well as K-uptake percent.

Soil No.	Clay %	W.S .K	K_{ex}	C.E.C	$-\Delta K^o$	AR_{ko}	PBC	EUF Parameters						K_n	K-uptake Percent
								K_{10}	K_{0-30}	K_{0-35}	K_{30-35}	F. I.	KQ		
Clay %			0.72	0.32	0.92	-	0.94	-	-	0.47	0.63	-0.63	0.67	0.68	0.56**
W.S.K			0.34	0.64	-	-	-	0.45	0.50	0.30	-	-	-	0.58	-
K_{ex}				0.33	0.63	-	0.62	0.48	0.68	0.91	0.95	-0.61	0.57	0.94	0.74**
K/C.E.C.					0.32	0.56	0.34	0.90	0.81	0.61	0.36	-	-	0.36	0.38*
$-\Delta K^o$						-	0.97	-	-	0.35	0.54	-0.57	0.72	0.58	0.41*
AR Ko							-	0.70	-	-	-	-	-	-	-
PBC								-	-	0.34	0.50	-0.57	0.69	0.56	0.52**
K_{10}										0.78	0.50	-	-	0.53	0.50**
K_{0-30}										0.90	0.67	-0.42	0.45	0.73	0.70**
K_{0-35}											0.92	-0.50	0.42	0.90	0.76**
K_{30-35}												-0.61	0.66	0.90	0.69**
F. I.													-0.63	0.52	0.54**
KQ														0.46	0.54**
K_n														-	0.72**

Critical r values
r = 0.45* at 0.05
r = 0.56** at 0.01

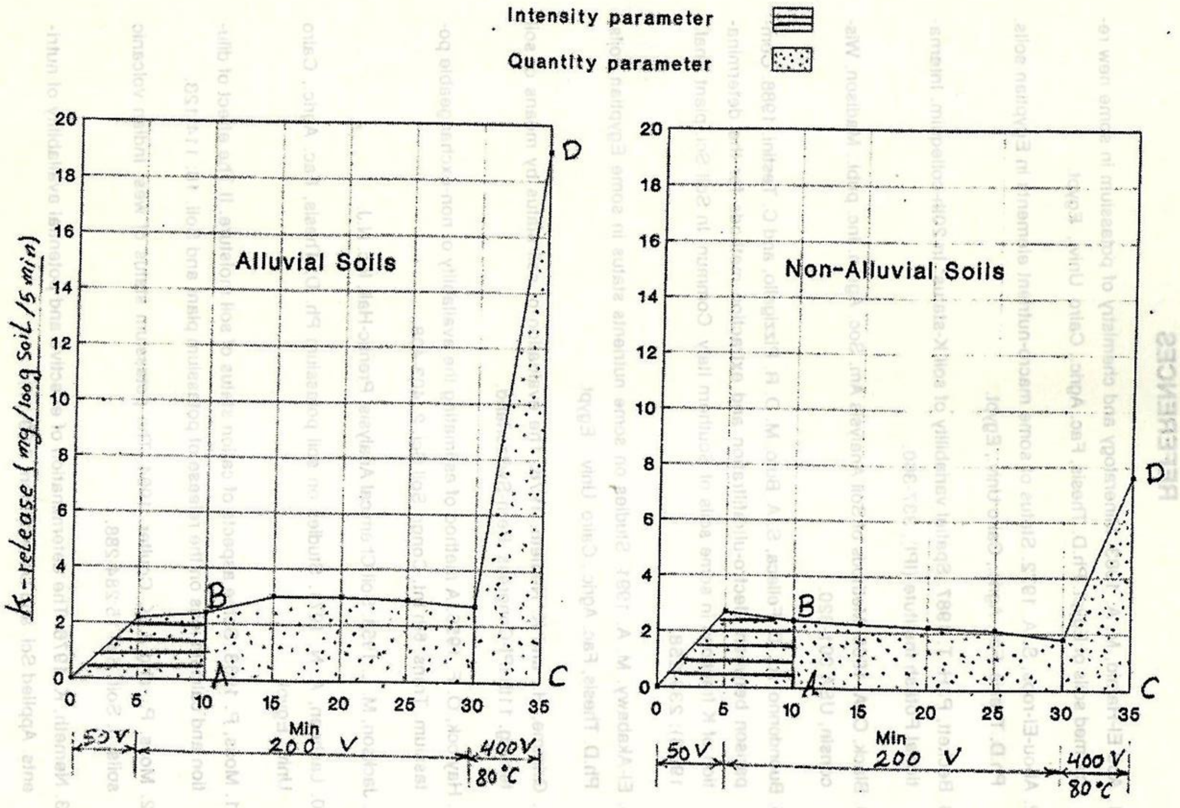

Fig. 1. EUF-K parameters characterizing K-availability of the two soil groups (mean values).

REFERENCES

1. Abd El-Hamid, M. A. 1983. Mineralogy and chemistry of potassium in some new reclaimed soils of Egypt. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

2. Abou-El-roos, S. A. 1972. Status of some macro-nutrient elements in Egyptian soils. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

3. Beckett, P. H. T. 1987. Spatial variability of soil K-status" In 20th collequim. International Potash Institute (IPI), 337-360.

4. Black, C. A. 1965. Methods of Soil Analysis Am. Soc. Agron. Inc. publ., Madison, Wisconsin, USA 301-320.

5. Buondonno, A., .D. Felleca, S. A. Bufo, M. D. R. Pizzigallo, and C. Testini. 1988. Comparison between electro-ultrafiltration and extraction methods for the determination of K fractions in some soils of Southern Italy. Commun. In Soil Sci. plant Anal., 19 (3): 239-258.

6. El-Akabawy, M. A. 1991. Studies on some nutrients status in some Egyptian soils. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

7. Grimme, H., and K. Nemeth. 1978. The evaluation of soil status by means of soil testing. 11th IPI-Congress. Bern-Switzerland.

8. Haylock, O. F. 1956. A method of estimating the availablity of non-exchangeable potassium. Trans. 6th Int. Congr. Soil Sci. 2, 403-408.

9. Jackson, M. L. 1958. Soil Chemical Analysis. Prentic-Hall, Inc. N.J.

10. Lasheen, A. N. 1971. Studies on soil potassium Ph. D. Thesis, Fac. Agric., Cairo Univ., Egypt.

11. Moss, P. 1963. Some aspects of cation status of soil moisture. II The effect of dilution and calcium ions on the release of potassium plant and Soil. 18: 114-123.

12. Moss, P., and J. K. Coulter. 1964. The potassium status of west Indian volcanic soils. J. Soil Sci. 15:284-288.

13. Nemeth, K. 1976. The determination of effective and potential availability of nutrients. Applied Sci. and Development 8:89-111.

14. Nemeth, K. 1979. The availability of utrients in the soil as determined by Electtro-Ultrafiltration (EUF) Adv. Agron., 31:155-188.

15.Nemeth, K. 1980. Electro-Ultrafiltration with varying voltage and temperature during the extraction process. Proc. Of the Int. Symp. On the application of EUF in the Agricultural production Budapest, Hungary, 17-57.

16.Nemeth, K. 1982. Electro-Utrafiltration of aqueous soil suspension with simultaneously varying temperature and voltage. Plant and Soil 42-7-11.

17.Shehata, H. M. A. 1981. The degree of release of certain elements from soils and different minerals under different conditions. Ph. D. Theis, Fac. of Agric., Al-Azhar Univ., Egypt.

18. Shehata, H. M. A., M. A. Abdel Salam and F. Abed. 1984. Detailed study on K-dynamic from some soils of Egypt . III Euf-K release at 80 ^{O}C in relation to some soil properties, chemical methods and soil minerals. Desert Inst. Bull., A.R.E., 34, No. 1, 2: 289-301.

19.Shehata, H. M. A., M. A. Abdel salam, and F. Abed. 1985. Detailed study on K-dynamics from some soils of Egypt II. Q/I relations and EUF-K of soils as measures of potassium availability. Desert Inst. Bull., A.R.E., 35:189-205.

20.Shehata, H. M.A., M. M. El-Shazly, and M. A. Ozoris. 1986. Evaluation of potassium in some soils of Egypt using EUF, chemical and Biological Methods. I. Comparison between EUF-K and K availability index by chemical methods. Desert Inst. Bull., A.R.E. 36: 95-108.

21.Simonis, A. D., and K.Nemeth. 1985. Comparative study on EUF and other methods of soil analysis for the determination of available potassium in soils from Northern Greece. Plant and Soil, 83:93-106.

22.Sinclair, A. H. 1982. A comparison of Electro-Ultrafiltration and quantity/intensity measurements of soil potassium with its uptake by ryegrass in Scottish soils. Plant and Soil, 64:85-94.

دراسة مقارنة بين طريقة الترشيح الكهربي الدقيق وبين بعض الطرق الشائعة لاستخلاص البوتاسيوم في بعض الاراضي المصرية

محمد عبد المحسن العقباري [1] ، فايزة محمد مرسي [٢]

١ , معهد بحوث الأراضي والمياة والبيئة – مركز البحوث الزراعية – جيزة – مصر .

٢ , المعمل المركزي لبحوث التصميم و التحليل الاحصائي – مركز البحوث الزراعية – جيزة – مصر .

تم استخدام بعض الطرق الشائعة لاستخلاص البوتاسيوم من ١٩ عينة تربة، مختلفه في محتواها من كل من الطين والبوتاسيوم ومأخوذة من مناطق مختلفة من أراضي مصر لتشمل أراضي الوادي والدلتا، وأراضي التوسع الجديدة، وقد تم مقارنه نتائج البوتاسيوم والمستخلص بهذة الطرق المختلفه (الذائب في الماء، وخلات الامونيوم، وحامض النيتريك، وكذلك مقاييس الكمية / الكثافه) بنتائج الطريقه الحديثه، وهي طريقة الترشيح الكهربي الدقيق (ت.ك.د) كما تم حساب رقم الارتباط بين البوتاسيوم المستخلص بكل من هذة الطرق وبين كميه البوتاسيوم النسبي الممتص بواسطة نبات البرسيم في تجربه أصص بالصوبة.

أظهرت النتائج بوضوح مدي الكفاءة العالية لطريقة (ت.ك.د) في التعبير عن حاله البوتاسيوم الغذائية في الأراضي تحت الدراسه، بالمقارنة بكل من الطرق الشائعه، وكذلك بالممتص بواسطة النبات وذلك نظرا لسهوله هذه الطريقة ودقه وصفها لحاله البوتاسيوم الميسر، استاتيكيا فقط بالاضافة إلي أن الطريقة الجديدة توفر الكيماويات والوقت المستخدمين بالطرق العادية، وقبل كل ذلك لأن هذه الطريقة أظهرت أعلي قيم أرتباط بالبوتاسيوم الممتص بالنبات وكذلك مع أفضل الطرق السابق أستخدامها وهي خلات الامونيوم.