

# Content of N,P, K in Some Representatively Albanian Soils Estimated by EUF Method

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## INTRODUCTION

Soil testing is an important tool in estimation of soil fertility. It is also an instrument to separate soils in different categories. A main problem of soil testing methods is that only a quantity of nutrients will be extracted in a certain time, and the intensity of nutrient release is little considerate in the management of N,P and K fertilization. An other aspect of soil testing methods is that the results of soil extraction methods are not well correlated with the nutrient uptake from plants. In the other side the bioavailability of soil-N, soil-P and soil-K was well correlated with data of soil extraction if the intensity/quantity concept of nutrient availability was considered in calculation of nutrient uptake from plants. The electroultrafiltration (EUF)-method is one tool in determining of nutrient quantity and the nutrient intensity of different soils. (Nemeth, 1979; Nemeth, 1985) Mengel and Uhlenbecker (1993) investigated the kinetics of the nonexchangeable K release by EUF and showed that kinetic parameters of nonexchangeable release employed by EUF were well correlated with the K uptake of ryegrass. Steffens (1994) showed that the bioavailability of soil-P was well predicted based on the kinetics of P release which were analyzed with a modified EUF extraction procedure. It seems that the EUF method is one tool, instead of the resin-exchange methods, to study the kinetics of desorption and dissolution of nutrients from soils for a basic characterization of nutrient status in relatively unknown soils. In many papers different authors have shown the importance of EUF to estimate the availability of plant nutrition, and to give recommendation for doses of fertilizers.

Considering the popularity of this method especially in Germany during 1993-1994 some soil samples were analysed by EUF and routine methods with objectives: ( i ) determine the status of N,P and K in Albanian soils, estimated by EUF method and ( ii ) determine the desorption rate of N,P and K measure by EUF. This study was carry out with soil samples from nine sites located at different locations of Albania. The kinetics of N,P and K release were employed with a modified EUF techniques.

## MATERIALS AND METHODS

In autumn 1992 soil samples were taken from nine different sites in Albania. The soil samples were sieved to pass a 4 mm sieve, were air-dried and were used for analyzing of soil texture and the mineralogy of clay fraction. For further physico-chemical analyzes the air-dried soils were ground to pass a 1mm sieve. Exchangeable P and K was determined by CAL-method (Ca acetate-Ca lactate-acetic acid method), Organic matter was determined by potassium dichromate method, Total N was determined by Kjeldahl method, Mineral and organic N was extracted with 0.01M CaCl<sub>2</sub> and was determined in autoanalyser. On the other side content of N,P and K in soil samples was extracted by EUF method. The principles of the EUF method is an extraction of ions in an electric field. (Nemeth, 1979) The EUF technique as a routine analysis method normally extracts two fractions: the first fraction is extracted from 0 to 30min at 20<sup>0</sup> C and 200V and the second fraction is extracted from 30 to 35min at 80<sup>0</sup> C and 400V (Nemeth, 1985). For analyzing the kinetics of N,P and K release, the nine topsoil were extracted by a modified EUF extraction. After two fractions that were extracted with the EUF routine-program, five other fractions were extracted every five minutes at 80<sup>0</sup> C and 400V. So, seven fractions were employed to analyze the kinetics of N,P and K release. The EUF extracts from

anode and cathode were mixed together. The first fraction was made up to a volume of 200 ml and others fractions were made to a volume of 100 ml with distilled water. The NH<sub>4</sub>-N, NO<sub>3</sub>-N and Norg. concentrations in the EUF extracts were measured by a autoanalyser, the K concentrations in the EUF extracts were measured by a flamefotometer and the P concentrations in the EUF extracts were analyzed with the Mo-blue method.

## RESULTS AND DISCUSSION

### Characteristics of the analyzed soils

The dates about the physical and chemical characteristics ( Tab 1 ) of the analyzed soils indicate a diversity in properties defined by geographical position and soil formation condition.

**Table 1. Some Physicochemical Characteristics of Analyzed Soils.**

NR	Sites	Clay (%)	Silt (%)	Sand (%)	Organic Matter (%)	Total N (%)	pH (CaCl <sub>2</sub> )
1	Shkodra 1	20.9	54.8	20.7	2.11	0.142	5.7
2	Shkodra 2	19.9	60.8	22.1	2.08	0.135	5.6
3	Shkodra 3	14.2	55.8	30.0	1.39	0.099	5.9
4	F.Kruje	46.9	52.9	0.2	2.36	0.155	7.3
5	Korca	26.8	63.0	10.2	1.31	0.086	7.8
6	Vlora	24.0	61.9	14.1	1.72	0.113	7.7
7	Durres	49.2	48.9	1.9	2.81	0.178	7.6
8	Lushnja 1	54.9	43.3	1.9	1.74	0.134	7.6
9	Lushnja 2	32.4	36.9	30.7	1.20	0.098	7.8

So, the selected soils in the Northern part of Albania ( Shkoder) are characterized by pH in the range from 5,6 to 6, 1, clay content in the range from 14.2 % to 26.4 %, the organic matter content from 1.39 % to 2.1%, and total nitrogen content from 0.054% to 0.142%. The prevalent minerals of clay fraction of this region are Illite and Kaolinite.

Western part (Fushe-Kruje, Durres, Lushnje, Vlore) are characterized by pH in the range from 7.3 to 8, clay content from 23.7% to 55% the organic matter content from 1.2% to 2.36% and total nitrogen content from 0.058% to 0.155%.The prevalent minerals of clay fraction in this region are Illite and Smectite.

Generally speaking, the selected soils are characterized by a heterogeneity in physical, chemical and mineralogical properties and in this way those soils are representatives of the dominant soils in Albania.

### Nitrogen

The dates about Nmin and Norg content extracted with CaCl<sub>2</sub> and EUF are given in Table 2

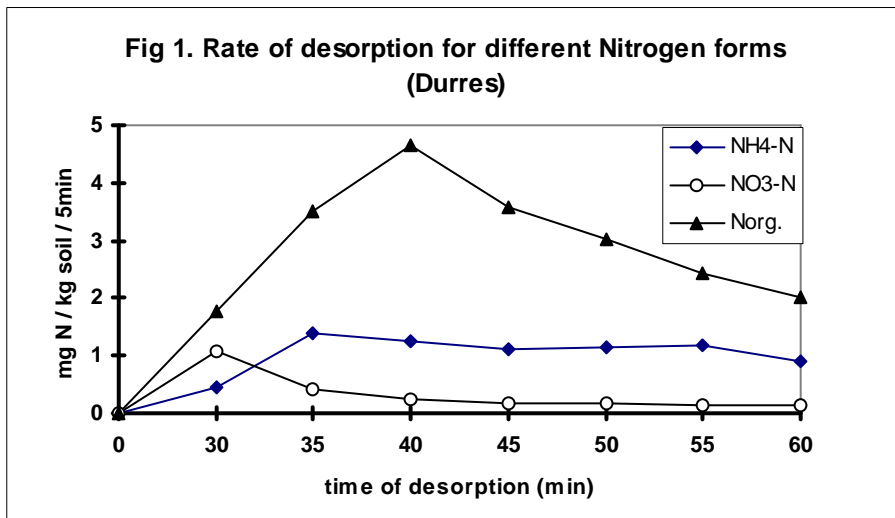
**Table 2. Content of Nitrogen in Analyzed Soils,**

	mg Nmin / kg soil extracted by:	mg Norg / kg soil extracted by:
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	CaCl <sub>2</sub>	EUF		CaCl <sub>2</sub>	EUF	
		0-30min	30-60min		0-30min	30-60min
SHkoder1	3.64	4.26	5.69	1.94	5.88	10.85
SHkoder2	4.10	4.54	6.99	2.49	5.78	11.30
SHkoder3	1.81	3.12	7.36	2.67	5.12	8.36
F.Kruje	23.33	23.37	8.03	6.70	8.52	19.93
Korce	27.53	27.44	5.13	2.09	5.16	17.18
Vlore	4.91	5.77	3.53	3.62	10.72	20.41
Durres	7.01	9.09	8.28	2.75	10.60	19.18
Lushnje1	7.11	10.01	7.23	3.44	9.56	14.55
Lushnje2	8.94	11.60	5.45	1.68	7.28	11.41
<b>Mes.</b>	<b>9.82</b>	<b>11.03</b>	<b>6.41</b>	<b>3.04</b>	<b>7.62</b>	<b>14.80</b>

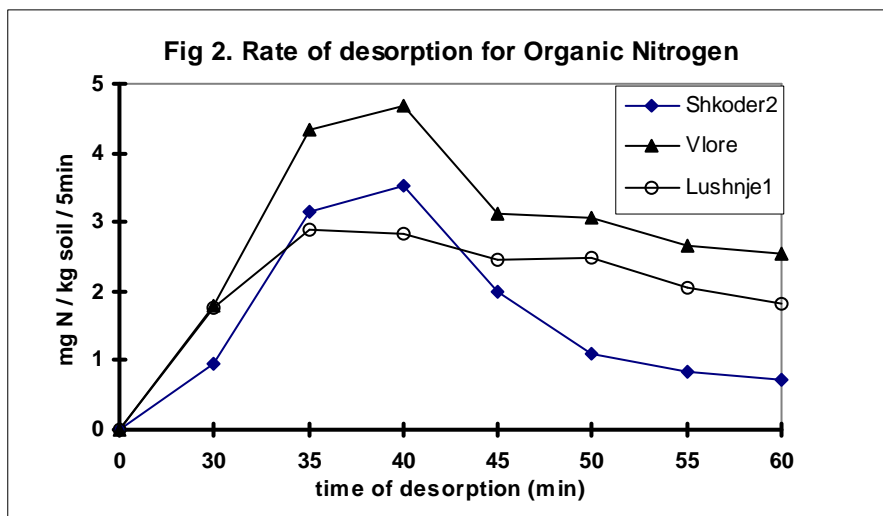
As you see N extracted with EUF is bigger than N extracted with CaCl<sub>2</sub>. This is true for all the nitrogen forms that we have determined. (NO<sub>3</sub>-N, NH<sub>4</sub>-N, and Norg.) But the difference between N extracted with EUF and CaCl<sub>2</sub> are more apparent in Norg case than in Nmin (NO<sub>3</sub>-N and NH<sub>4</sub>-N). So, we can see that with EUF is extracted about seven time more Norg than with CaCl<sub>2</sub>, while for Nmin this difference is only about 70%.

Differences exist also between EUF-N extracted in 20°C and 200V and EUF-N extracted in 80°C and 400V. So, only during extraction in 80°C and 400V are extracted about 66% of Norg, 68% of NH<sub>4</sub>-N and 20% of NO<sub>3</sub>-N compared with total EUF-N extracted.



As you can see in Fig 1. the rate of desorption presents apparent differences. So, the desorption rate of NO<sub>3</sub>-N in 80°C and 400V is strong decrease compared with the desorption in 20°C and 200V. The contrary happens with the desorption rate of NH<sub>4</sub>-N. The desorption rate in 80°C and 400V is increase strongly compared with the desorption in 20°C and 200V.

As far as the extraction of Norg in 80°C and 400V is concerned we see that have an apparent increase of N-extracted in first 10-15minutes and then a decrease of the desorption rate. The desorption rate of Norg is determined and from soil texture as is presented in Fig 2.



Knowledge about EUF-N and especially about EUF-Norg gives valuable information in nitrogen fertilization field. So, according to Wiklicky and Nemeth (Nemeth,1985), 1mg EUF-Norg / 100g soil--measured in topsoil under cereal during summer-- corresponds to 50kg N / ha in following year for sugar beet.

## Phosphorus

The dates about **Phosphorus** content extracted with CAL and EUF are given in Table 3.

**Table 3. Content of Phosphorus in Analyzed Soils,**

	mgP/kg soil extracted by:					EUF-PQ
	CAL	EUF				
		0-30min	30-35min	30-60min	0-60min	
SHkoder1	24.64	2.09	1.73	12.80	14.89	0.83
SHkoder2	31.80	3.45	2.26	16.12	19.57	0.66
SHkoder3	42.25	9.75	7.93	43.98	53.73	0.81
F.Kruje	13.10	3.96	4.35	30.74	34.70	1.10
Korce	8.25	2.61	1.87	14.14	16.75	0.72
Vlore	18.70	2.66	2.93	21.18	23.84	1.10
Durres	10.60	6.27	2.64	23.90	30.17	0.42
Lushnje1	19.30	3.00	3.40	23.16	26.16	1.13
Lushnje2	63.75	8.51	8.91	52.36	60.87	1.05
<b>Mes.</b>	<b>25.82</b>	<b>4.70</b>	<b>4.00</b>	<b>26.49</b>	<b>31.19</b>	<b>0.85</b>

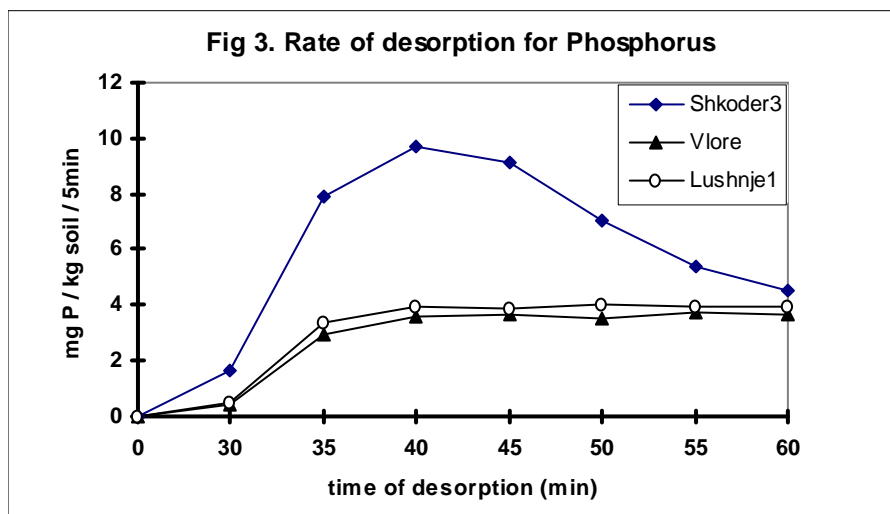
Depending on the level of P concentration in soil solution, about 5-10% Lactate P as determined in many European testing laboratories can be extracted by EUF.(Nemeth, 1982)

In our soils we have similarly ratios. For our samples P extracted by EUF in 20<sup>0</sup>C and 200V represents only 10-30%of P extracted by CAL, except one sample selected in Durres region where P extracted by EUF in 20<sup>0</sup>C and 200V represents about 60% of P extracted by CAL.

Long term experiments have shown that quantities of P that are easily available to a crop during a vegetation period can be well characterized by EUF in 20<sup>0</sup>C and 200V during 30 minutes. These studies showed that EUF-P value of 1.4-1.6 mg / 100g soil / 20<sup>0</sup>C and 200V is necessary for optimal plant nutrient (Nemeth, 1982). In all the soils studied ,except the soils in Shkodra and Lushnja region,there exist low values of EUF-P compared with recommended EUF-P for optimal plant nutrition given in literature.

The subsequent extraction at 80<sup>0</sup> C and 400 V gives information on P reserves. The soils studied are characterized by similar quantities between P extracted in 20<sup>0</sup> C and 200 V during 0 to 30 minutes, and 80<sup>0</sup> C and 400 V during 30 to 35 minutes. Generally the ratio EUF-P-80<sup>0</sup> C / EUF-P-20<sup>0</sup> C (EUF-P<sub>Q</sub>) is about 0.7-1.1. An exception is the selected soil in Durres region where the above ratio is 0.4.

In Figure 3 is presented the rate of P-desorption.



The analysed samples show a high rate of potassium desorptions. During the extraction in 80<sup>0</sup> C and 400 V. This rate in the samples with high levels of EUF -P<sub>Q</sub> is nearly constant during the whole time of extraction in 80<sup>0</sup> C and 400 V. These data show the presence of phosphorus forms with low assimilation level.

## Potassium

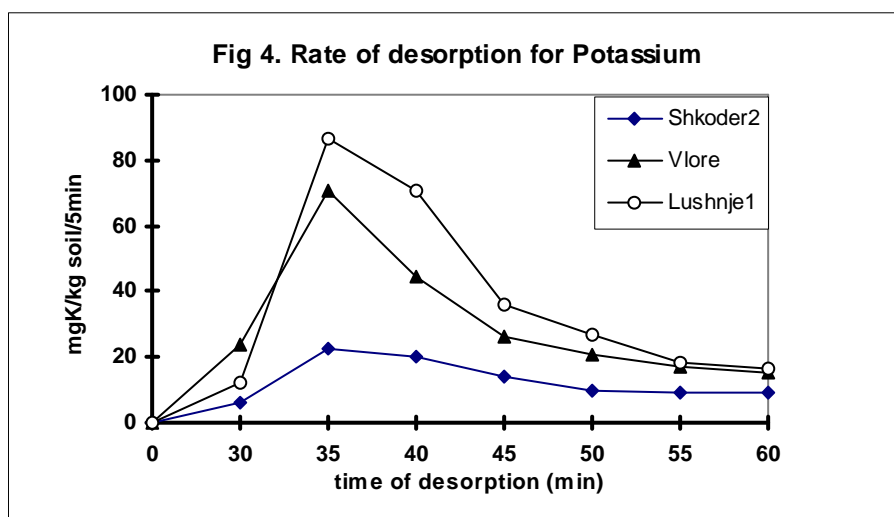
The data about Potassium content extracted with CAL and EUF are given in Table 4. K-extracted in 20<sup>0</sup> C and 200 V during 30 minutes represents exchangeable potassium and level of assimilation is high. The data show that content of those forms are in high quantity in analyzed samples. During the extraction in 80<sup>0</sup> C and 400 V is released about 2.5 times more potassium than in first 30 minutes. According to many authors this has to do with the extraction of nonexchangeable potassium placed in the structures of clay-minerals. This potassium is an important source for the plant nutrition. Another important index is the EUF-K<sub>Q</sub> given from ratio EUF- K- 80<sup>0</sup> C / EUF- K- 20<sup>0</sup> C. According to the literature for the evaluation of the soil potential about the K supplying is important to know not only EUF- K- 20<sup>0</sup> C but also EUF- K<sub>Q</sub>. The high values of EUF-K<sub>Q</sub> show the high potential of the soil for K-release. Comparing the literature our soils generally have a high potential for K.

The rate of K-desorption of some soils is presented in Figure 4. The data shows clearly that the rate of K-desorption is influenced from soil texture, especially if we compare data from Vlora and Lushnja regions. Thus, in above-mentioned regions quantity of K-desorption is nearly equal, but the rates of desorption is quite different.

**Table 4. Content of Potassium in Analyzed Soils,**

	mgK/kg soil extracted by:					EUF-K <sub>Q</sub>
	CAL	EUF				
		0-30min	30-35min	30-60min	0-60min	
SHkoder1	34.35	27.31	20.09	73.06	100.37	0.74
SHkoder2	41.55	35.52	22.42	85.70	121.22	0.63
SHkoder3	52.45	35.97	21.31	78.77	124.74	0.59
F.Kruje	153.35	78.59	88.44	226.01	304.60	1.13

Korce	95.35	59.94	57.06	150.43	210.37	0.95
Vlore	177.70	143.42	70.71	193.70	337.12	0.49
Durres	138.80	81.70	74.29	266.46	348.16	0.91
Lushnje1	141.05	74.44	86.81	255.36	329.80	1.17
Lushnje2	111.50	110.66	80.83	199.68	310.34	0.73
Mes.	105.10	71.95	58.00	169.90	242.90	0.82



## Literature

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