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Estimation of Extractable Potassium in some Selected Soils in Albania.

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Abstract

Exchangeable and nonexchangeable forms of potassium are important indicators for assessing the potential of soil for the supply plants with potassium. There are carry out several studies to evaluate the exchangeable and nonexchangeable forms of potassium in some Albanian soils with CAL and EUF extraction methods, as well as the relations between them.

The purpose of this study is to evaluate the exchangeable forms of potassium using different extraction methods as Mehlich-3, Ammonium Acetate and Distilled Water as well as nonexchangeable forms of potassium extracted with 1 N solution of HNO_3.

For this purpose, 8 soil samples were collected in the western regions of Albania. The samples were analysed for the contents of exchangeable and nonexchangeable forms of potassium according to the respective methods. The results show that the soil contains 467.3 – 1002.7 mg K kg^{-1} soil when extracted with 1 N solution of HNO_3. Amount of potassium extracted with the Mehlich-3method was 55,1 – 379.5 mg K kg-1 soil, with Ammonium Acetate was 61.1- 329.0 mg K kg^{-1} soil, and with Distilled Water was 7.6 – 86.0 mg K kg^{-1} soil.

A good correlation exists between the quantity of potassium extracted by Ammonium Acetate and Mehlich-3, but not with water extraction.

Key words: Potassium, Exchangeable and Nonexchangeable forms, extraction methods,

Introduction

Fractions of Potassium in soil are (a) total potassium, (b) nonexchangeable (but plant-available) potassium, (c) exchangeable potassium and (d) water-soluble potassium. The most common test for available K^+ is the exchangeable K^+ obtained by extraction with 1M NH_4Cl or NH_4OAc. **[5]**

Different techniques are proposed in the literature to determine the available K in soils by extraction with diluted salt solutions**.[4][6][7]** The soil testing results are used for K fertilizer recommendations. **[1]**

The neutral normal Ammonium Acetate, and Mehlich-3 solution which extracts both solution and exchangeable K are used for evaluating plant-available soil K in most soil testing laboratories. **[4][6][8]**Also, is suggested the non-exchangeable K extracted by boiling 1 N nitric acid (HNO_3) method as the index of long-term K supplying ability of many soils**[8]**

Exchangeable and non-exchangeable forms of potassium are important indicators for assessing the potential of soil for the supply plants with potassium. Soil test methods should take into consideration the major factors and processes relevant to the availability of a particular plant nutrient**.[5]**The closest correlations between soil tests and plant were found in potassium**.[3]**

There are carry out several studies to evaluate the exchangeable and nonexchangeable forms of potassium in some Albanian soils with CAL and EUF extraction methods, as well as the relations between them**.[2][9]**

The purpose of this study is to evaluate the soluble and exchangeable forms of potassium using different extraction methods as Mehlich-3, 1N Ammonium Acetate and Distilled Water as well as

nonexchangeable forms of potassium extracted by boiling 1 N HNO_3 method.

Materials and methods

Soils from eight different sites in the western regions of Albania are used. The soil samples were air-dried, were sieves to pass a 2 mm sieve, and were used for analyzing of physical and chemical properties as:

Soil Texture (Hydrometer method); Organic matter (Potassium dichromate method); pH-H_2O (1:5 soil – water ratio); Total Nitrogen (Kjeldahl Method); Available Phosphorus. (Mehlich 3 Method)

Some data on physical and chemical properties of the soil selected for this study are presented in Table 1.

Table 1. Physical chemical properties of selected soils.

	Organic Matter %	pH-H_2O	Total Nitrogen mg kg^{-1}	Available phosphorus mg kg^{-1}	Sand %	Silt %	Clay %
Minimum	0,5	7,7	590,0	3,0	6,5	8,6	8,2
Maximum	2,8	8,8	2147,0	36,9	38,9	58,8	81,2
Average	1,4	8,2	1014,5	16,0	15,2	42,5	42,3
DevSt	0,81	0,42	505,20	11,86	9,35	23,81	27,50

In other side, the samples were analysed for the contents of extractable forms of potassium according to the following methods:

Potassium water soluble (K – H_2O), **[7]**

Potassium extracted by NH_4OAc(K – NH_4OAc) **[7]**

Potassium extracted by Mehlich 3 (K – Mehlich 3) **[4]**

and Potassium extracted by Nitric Acid (K – HNO_3)**[7]**

Results and discussions.

Potassium extracted by different methods

The minimum, maximum and average dates about Extractable K content extracted with 1N HNO_3; Mehlich–3; 1N NH_4OAc and Distilled Waterare given in Table 2. From the extraction methods selected in this study, the largest amount of potassium in the soils studied was extracted by1N HNO_3extraction solution. While, the smallest amount of potassium in the soils was extracted during extraction with H_2O solution.The results show that amount of potassium extractedby1N $HNO_3$was 467.3 – 1002.7 mg K kg^{-1} soil,amount of potassium extracted with the Mehlich–3 method was 55,1 – 379.5 mg K kg^{-1} soil,with 1N NH_4OAc was 61.1- 329.0 mg K kg^{-1}soil and with distilled H_2O was 7.6 – 86,0 mg K kg^{-1} soil.

Table 2. Soil Potassium extracted by different methods.

	mg K kg^{-1} soil extracted by:			
	1 N HNO_3	Mehlich–3	1 N NH_4OAc	Distilled H_2O
Minimum	467,3	55,1	61,1	7,6
Maximum	1002,7	379,5	329.0	86.0
Average	701,0	172,8	169,4	49,4
StDev	184,1	100,3	80,2	30,3

The differences in the exchangeable potassium extracted by Mehlich– 3 and NH_4OAc methods are very closed. While the amount of exchangeable potassium extracted with distilled H_2O is about 2-14 time smaller than in the above-mentioned methods.This is true for both extraction methods that we have analysed.

Correlations between different extraction methods.

The different methods of extraction used in this study are correlated with each other and with the clay content. The results are presented in Table 3 and Figures 1 and 2.

Table 3. Thecoefficients of determination (r^2) for the analysed indicators.

	Clay	K-HNO_3	K-Mehlich 3	K- NH_4OAc	K-H_2O
Clay	1				
K-HNO_3	**0,752**	1			
K-Mehlich 3	0,309	**0,589**	1		
K- NH_4OAc	0,417	**0,601**	**0,954**	1	
K-H_2O	0,403	0,293	0	0,015	1

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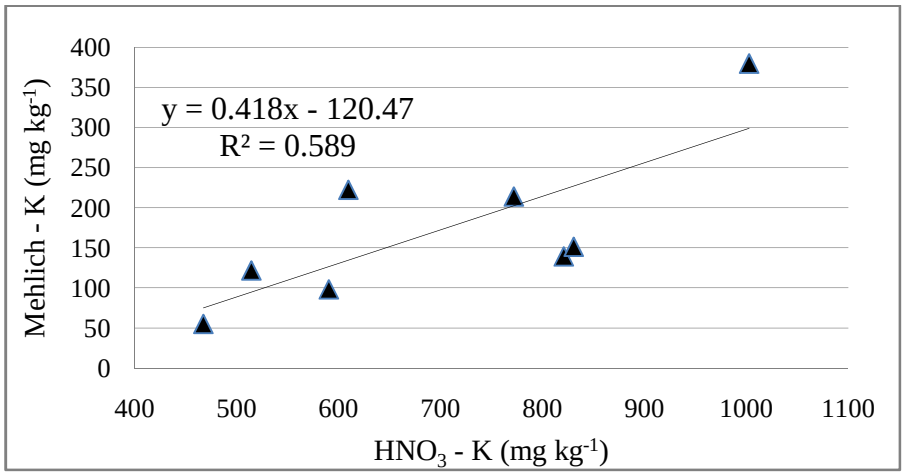

Figure 1. Potassium in soil extracted by HNO_3 and Mehlich 3 methods

A good correlation exists between the quantity of potassium extracted by Ammonium Acetate and Mehlich–3, but not with distilled H_2O extraction

A soil important factor that influence in variability of Kextracted from selected soils is the clay content. The dates indicate strong relationship between clay content in one side and potassium extracted by 1N HNO_3 on the other side.

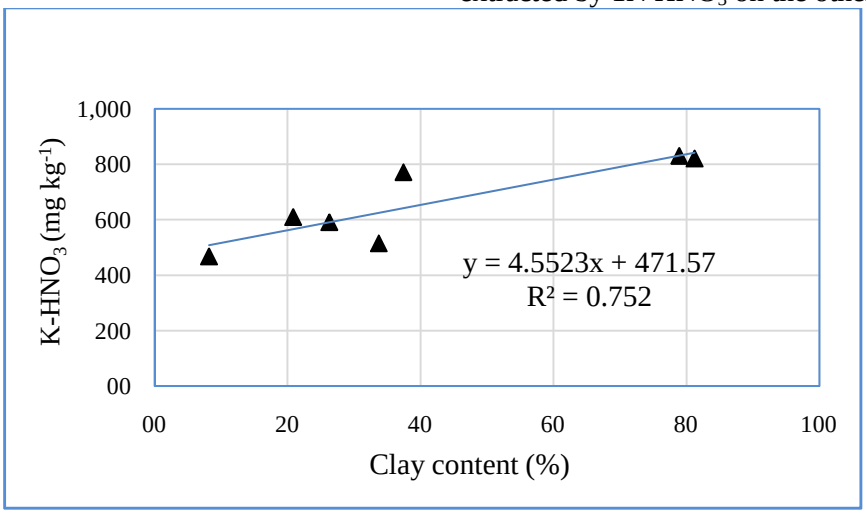

Figure 2: Correlation between clay content and K extracted by 1N HNO_3

Correlations of clay content and potassium extracted by other methods are weak (Table 3)

However, the quantity of exchangeable potassium extracted by Mehlich–3 and 1 N NH_4OAc methods tend to increase related to clay content. While the amount of exchangeable potassium extracted with distilled H_2O has a decreasing trend in relation to clay content.

Conclusions

The content of nonexchangeable potassium in the soil at the range of 460-1000 mg kg^{-1} soil extracted with 1 N HNO_3 method and content of exchangeable potassium in the soil at the range 55-380 mg kg^{-1} soil extracted by Mehlich–3methods and at the range 60-330 mg kg^{-1} soil extracted by 1N NH_4OAc method.

A good correlation exists between the quantity of potassium extracted by 1N NH_4OAc and Mehlich–3, but not with distilled H_2O extraction.

A good correlation exists between clay content in one side and potassium extracted by 1N HNO_3 on the other side.

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