Comparative study on EUF and other methods of soil analysis for the determination of available potassium in soils from Northern Greece

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Summary Twenty-one representative soils from Northern Greece could be grouped into three categories based on the EUF-K curves which displayed marked differences in the magnitude of K release by the soils employed. The cumulative K desorption by EUF within 35 min and the cumulative K-uptake values of ryegrass (10 cuts) were found to be correlated \( r = 0.87^{**} \). Although this correlation is rather close, the K dynamics of a soil can be better characterized by the course of the K-desorption curves. Because the quotient \( \frac{\text{EUF-K-80°C}}{\text{EUF-K-20°C}} \) can give information on the course of K desorption it is therefore sufficient in routine investigations to know the EUF-K-20°C contents and the numerical values of the quotients \( \frac{\text{EUF-K-80°C}}{\text{EUF-K-20°C}} \).

The EUF procedure does not only indicate the close relationship between K extracted and K uptake by plants, but it can also provide information on other nutrients in the same soil sample. With this extra information it was possible to explain why in some of the analysed soils K uptake was low despite high K availability, the reason being that P availability was not optimal in one of the experimental soils and that the Mn concentration of the soil solution was too high in another. At equal K availability the K uptake was also dependent on the amount of EUF-extractable N.

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\(^1,8,9,10,15,16,18,19,20,21\). The desire for a less empirical foundation of soil analysis has led experimenters to specify the parameters which must be considered in defining potassium availability in soils. This entails intensity, quantity and rate parameters\(^2,3,4,11,23\). These parameters, however, can diverge widely in different soils depending on numerous soil properties. In recent years the EUF method has been gaining recognition from soil chemists in many countries\(^12,13,14,17,22\). This method provides a means of assessing the
potassium availability in soils more comprehensively and could be adopted as a tool for widespread application\textsuperscript{14}.

The objective of the present study was to compare the relative efficiencies of EUF and other soil analysis methods for determining available potassium in twenty-one soils taken from various locations in Northern Greece as defined by K uptake and dry-matter yield of rye-grass grown in pots.

Materials and methods

Laboratory experiments

Soils used and their characteristics. A total of twenty-one surface (0–25 cm) soils representing the main soil types of Northern Greece were selected to give a range of parent materials, texture and clay mineralogy. Table 1 gives some characteristics of the soils employed. Methods used for the determination of potassium availability are given in Table 2. EUF-K was determined by means of the EUF apparatus at the Büntehof Agricultural Research Station Hannover. The quantities of K extracted in 5-minute intervals at 20°C and 200 V were summed up and the cumulative EUF-K values were plotted against the desorption time in minutes. The EUF-K contents at 80°C and 400 V were also determined during 30–35 min, as this extraction duration had proved adequate in practice.

Experiments with plants

For correlations between soil analysis data and K uptake by plants the following pot-culture technique was employed:

One kg of soil with 400 g of properly washed sand, thoroughly mixed, along with a basal nutrient solution containing 200 mg N and 100 mg P and water were placed in plastic pots. The soil of each pot was sown with 1.5 g rye grass seed and then the pots were placed on a glasshouse bench according to the randomization scheme. Each pot stood in a plastic saucer which was used for watering. The grass was cut ten times about 1.0 cm above soil level at 4–5 week intervals and after each cut extra nutrients, without potassium, were applied. The foliage was dried immediately at 80°C, weighed and ground. The dry matter of plant material was ashen at about 550°C, the residue was dissolved in a solution of 20% HCl and K was determined by flame photometry. The cumulative dry-matter yield and the cumulative K-uptake values were calculated and correlations were worked out between these biological indices and the various soil K-availability indices.

Results

Characteristics of the analysed soils

On account of their origin from different geological formations the physico-chemical characteristics of the soils revealed a wide heterogeneity (Table 1). This table shows that clay contents vary between 5.2 and 48.8%, pH values between 4.6 and 7.6, CEC between 12 and 50 meq/100 g, CaCO\textsubscript{3} contents between 0 and 14.7% and the contents of organic substances between 0.9 and 11.8%.

Potassium status of the analysed soils

The ranges of K values obtained with different extractants for