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A RAPID NONDIGESTION METHOD FOR DETERMINATION OF POTASSIUM IN PLANT TISSUE

KEY WORDS: Triacid digestion, HCl extraction, ammonium acetate, ammomium acetate-magnesium acetate, H_2SO_4-Se digest, Crops

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ABSTRACT

A simple, rapid and precise method that does not involve digestion has been described for determination of plant K. The method involves shaking of 0.5 g of finely ground plant materials with 40 ml of 0.5 N HCl for 5 minutes. The extract is filtered and read in an Atomic absorption spectrophotometer for K. The method gives K values that are in close agreement with those obtained with conventional digestion techniques for different crop plants and provides better precision and rapidity for determination of K in plant tissue.

INTRODUCTION

Minerals and trace elements in plant tissue are usually determined following wet digestion techniques involving digestion with triacid or diacid mixtures[1]. Recently a method has been proposed for estimation of plant K using extraction of the plant materials with magnesium acetate and ammonium acetate thus avoiding digestion of

the plant material[2]. We required a method that is simple, precise and rapid at the same time to enable handling of a large number of plant samples for K analysis. Comparative evaluation of the different techniques used for K analysis in plant tissue led to the development of a simple and rapid test for K, which is described here. The method does not involve digestion of the plant tissue and requires extraction with 0.5 N HCl for 5 minutes followed by reading of K in the atomic absorption spectrophotometer.

MATERIALS AND METHODS

Our preliminary work showed that extraction of the finely ground plant materials with 0.5 N HCl for 5 minutes gave quantitative recovery of the plant K. The final method used on the basis of preliminary work on the time of shaking, concentration of HCl and the ratio of plant material weight to volume of HCl used is as follows:

Method

0.5 g of the finely ground plant material ($<$ 60 mesh) is shaken with 40 ml of 0.5 N HCl for 5 minutes in a reciprocating shaker. The suspension is filtered through Whatman No. 1 filter paper and K in the extract is determined by an atomic absorption spectrophotometer (Varian Techtron 1200 model was used in our studies).

The values of K determined in plant tissue by the proposed method were compared with those obtained by the following techniques.

1. Triacid digestion: 0.5 g plant material was digested with 12 ml of triacid mixture of HNO_3, H_2SO_4 and $HClO_4$ (9:2:1 v/v) for 3 h in cold followed by digestion for about 2h on a hot plate.

2. Digestion of the plant material with H_2SO_4 containing 0.5% Se powder

   0.5 g of the ground plant material was digested at 370°C in 250 ml digestion tube for 2-2½ h on a heating block with 14 ml of H_2SO_4 containing 0.5% Se and K determined in the digest by atomic absorption spectrophotometer.

3. Extraction with magnesium acetate + ammonium acetate solution[2]

   0.5 g of the plant material was extracted with 100 ml of a mixture of 2 N NH_4OAc and 0.2 N Mg $(OAc)_2$ solution for 2 h in a reciprocating shaker. The suspension was filtered and K head in an atomic absorption spectrophotometer.

4. Extraction with 1 N ammonium acetate solution:

   This is a modified method employed to test whether ammonium acetate alone could be used for extraction of K from the plant tissue. The method is similar to that described at 3 except that 1 N NH_4OAc alone was used for extraction of the plant material. 0.5 g of the plant material was shaken with 100 ml of 1 N NH_4OAc for 2 h and K determined as described.

5. Extraction with 0.5 N NH_4OAc solution:

   This method is essentially the same as described under 4 except in that the concentration of NH_4OAc used was 0.5 N instead of 1 N as employed in methods.

RESULTS AND DISCUSSION

The values of plant K in different crops determined by the proposed HCl extraction method as compared to triacid digestion technique are given in Table 1. The results indicate that the values obtained by the proposed method are in close agreement with those obtained by the triacid digestion of the maize, groundnut, pigeonpea and chickpea plant tissue.

TABLE 1

Comparison of HCl extraction and triacid digestion methods for determination of plant K

Crop	No.of samples analysed	Triacid K (%) Range	Triacid K (%) Mean	HCl K (%) Range	HCl K (%) Mean
Maize	20	0.54-4.15	1.54	0.54-4.39	1.59
Groundnut	16	1.56-3.71	2.14	1.62-3.50	2.14
Pigeonpea	20	1.09-2.00	1.68	1.08-1.95	1.68
Chickpea	23	1.41-2.67	2.06	1.37-2.54	2.01

The amount of K in the plant tissue by the triacid digestion method ranged from 0.54 to 1.15% while with the HCl extraction technique, the values for plant K ranged from 0.54 to 4.39% in the 79 plant tissue analysed.

Comparison of the plant K values obtained by the proposed method and the other 5 methods showed that the plant K values by the

TABLE 2

Comparative value of different methods for determination of plant K (n=16)

Method	% K in plant tissue Range	Mean
1. Triacid digestion	1.56-3.71	2.14
2. H_2SO_4 + Se digestion	1.59-3.57	2.14
3. 0.5 N HCl extraction	1.62-3.50	2.14
4. 0.5 N NH_4OAc extraction	1.57-3.46	2.13
5. 1 N NH_4OAc extraction	1.65-3.85	2.23
6. NH_4OAc + $Mg(OAc)_2$	1.66-3.76	2.24

TABLE 3

Precision of the HCl extraction and the triacid digestion methods for determination of plant K

Method	% plant K*			
	Range	Mean	S.D.	C.V.
HCl extraction	1.90-2.02	1.955	0.038	1.96
Triacid	1.81-1.99	1.899	0.058	3.05

* Nine analyses. S.D., standard deviation; C.V., Coefficient of Variation

proposed technique were in close agreement with the values obtained by Triacid and H_2SO_4 + Se digestion techniques and the 0.5 N ammonium acetate extraction method. But extraction with 1 N NH_4OAc extraction or extraction with a mixture of NH_4OAc - $Mg(OAc.)_2$ solution gave higher values for K (Table 2). These results indicate that HCl or NH_4OAc extraction could be conveniently employed for K analysis in plant plant tissue with rapidity and accuracy.

The precision and accuracy of the proposed method is further indicated by the lower standard deviation (SD) and coefficient of (CV) obtained by this method compared to the triacid technique (Table 3).

Because of the simplicity and high precision obtained with the proposed method, this will be very suitable to handle a very large number of plant tissue analysis for K.

REFERENCES

1. M.L. Jackson, Soil Chemical Analysis, Prentice Hall (India), New Delhi (1967)

2. Tech. Bull No. 3, International Soil Testing, (December 1968)