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POTASSIUM DETERMINATION IN GRAIN SAMPLES USING THE NONDIGESTION (DILUTE HCL EXTRACTION) METHOD[1]

KEY WORDS: HCl extraction, triacid digestion, seed material

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ABSTRACT

A nondigestion method described earlier for K determination in plant tissue was tested for measuring K in grain samples of chickpea, pigeonpea, sorghum and pearl millet crops. The method involves shaking 0.5 g of finely ground (< 0.4 mm) seed sample with 40 ml of 0.5 N HCl for 5 minutes at room temperature (≈ 25°C). The values of K obtained by this method with grain samples of the four crops were in close agreement (r = 0.997) with those obtained using the conventional triacid digestion technique. These results suggest that this method may also be used for routine rapid and precise K analysis is seed materials of different crops.

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INTRODUCTION

In an earlier communication I described a nondigestion method for determining K in plant tissue of different crops[4]. The method was tested for estimating K in diverse plant tissue of maize, groundnut, pigeonpea and chickpea crops with a wide range of K content. The method gave K values that were in close agreement with those obtained by the conventional digestion techniques, and it is simple and rapid for K determination in plant tissue. The method involves extraction of K from finely ground plant samples by shaking them with dilute HCl for a short time followed by measurement of K in the extract with an atomic absorption spectrophotometer.

In an earlier study, Attoe[2] found that the values of K in plant tissue determined by ammonium acetate-magnesium acetate extraction method were similar to those obtained by the digestion method. Recently, Sahrawat[4], however, showed that the HCl extraction method was more precise than the ammonium acetate-magnesium acetate or ammonium acetate extraction methods for K determination in plant tissue.

The aim of this work was to test the HCl extraction method for determining K in grain samples of different crops. Evaluations of grain samples were desirable because the seeds of a crop have a different composition and texture from those of the plant tissue and thus extractability of K might differ. The results described provide evidence to show that the HCl extraction method can also be used for routine K determination in seed materials.

MATERIALS AND METHODS

Grain samples of chickpea (*Cicer arietinum* L.), pigeonpea (*Cajanus cajan* (L.) Millsp.), sorghum (*Sorghum bicolor* (L.) Moench) and pearl millet (*Pennisetum americanum* (L.) Leeke) crops were selected

from large numbers of samples received in our analytical laboratory for various analyses to provide a range in K content.

The whole grain samples of these different crops were ground in an Udy cyclone mill (Udy Analyzer CO., Boulder, Colorado, U.S.A) using 0.4 mm screen. The ground samples were dried in the oven at 60°C for 24 hours before analysis.

Method

The method used is the same as described earlier[4]. Briefly, ground seed material (0.5 g) was shaken with 40 ml of 0.5 N HCl for 5 minutes in a reciprocating shaker. The suspension was filtered through Whatman No. 1 filter paper and K in the extract was determined using an atomic absorption spectrophotometer (a Varian Techtron, 1200 model was used in this study). The values of K obtained using this technique were compared with those determined by the triacid digestion method[3] as described earlier[4].

RESULTS AND DISCUSSION

The values of K in the 56 diverse grain samples of the four crops determined by the HCl extraction (HCl-K) method were in close agreement ($r = 0.997$) with the values obtained by the triacid digestion (Triacid-K) technique (Fig. 1). The regression equation describing the relationship between the two methods can be represented by the following equation:

$$\text{HCl-K} = 0.0297 + 0.934 \quad (\text{Triacid-K})$$

$$R^2 = 99.4\%$$

The content of K in the grain samples determined by the triacid digestion method ranged from 0.27 to 1.35% while with the HCl extraction technique the K values ranged from 0.25 to 1.42%. The ranges and means of K values obtained by the two methods for grain samples of the four crops showed that the values of K determined by the HCl extraction method were

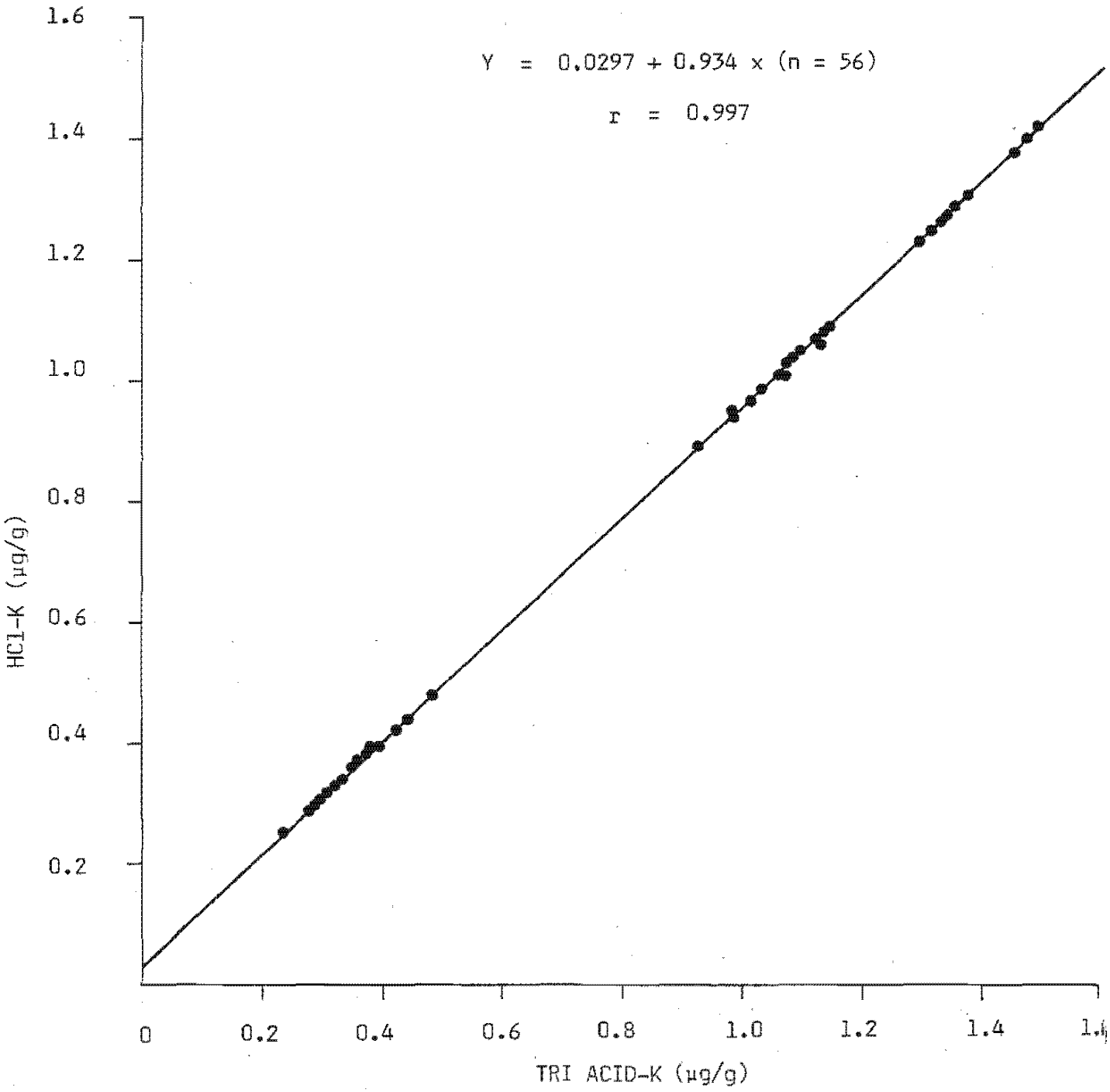

Fig.1. Correlation between K values determined by triacid digestion and HCl extraction methods.

similar to those obtained by the digestion technique for the grain samples of the each crop (Table 1).

The precision and accuracy of the proposed method is further borne out from the data on standard error (SE) of K determination for different crops, which showed that the HCl extraction method provided precision comparable to the triacid digestion technique (Table 2).

TABLE 1

Comparison of the HCl extraction (HCl-K) and the triacid digestion (Triacid-K) methods for determination of K in grain samples of different crops.

Crop	No. of samples	Triacid - K (%) Range	Triacid - K (%) Mean	HCl - K (%) Range	HCl - K (%) Mean
Chickpea	16	0.85 - 1.05	0.97	0.89 - 1.12	1.02
Pigeonpea	10	1.20 - 1.35	1.28	1.23 - 1.42	1.32
Sorghum	15	0.27 - 0.46	0.35	0.25 - 0.44	0.34
Pearl millet	15	0.28 - 0.53	0.36	0.29 - 0.48	0.36

TABLE 2

Precision of the HCl extraction and the triacid digestion methods for determination of K in grain samples.

Crop	Method	*K Content (%) Range	Mean	SE
Chickpea	HCl extraction	0.94 - 0.98	0.958	± 0.0133
	Triacid	0.94 - 0.97	0.957	± 0.0125
Pigeonpea	HCl extraction	1.65 - 1.68	1.660	± 0.0110
	Triacid	1.61 - 1.65	1.627	± 0.0170
Sorghum	HCl extraction	0.50 - 0.53	0.518	± 0.0117
	Triacid	0.50 - 0.55	0.530	± 0.0220
Pearl millet	HCl extraction	0.65 - 0.67	0.660	± 0.0063
	Triacid	0.63 - 0.64	0.635	± 0.0050

*Based on five independent analyses

The HCl extraction method is simple, rapid and precise and thus may find preference over the digestion techniques for K determination in plant and seed materials.

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