

# THE PRACTICAL ADAPTATION OF THE MODIFIED ISFEI\* METHOD OF SOIL EXTRACTION

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## Introduction

Soils that have a high organic matter content yield dark to very dark extracts with the ammonium bicarbonate based, modified ISFEI extractant (Original ISFEI by Hunter, 1974). Decolouration for colorimetric methods is essential. This is done by coagulation of the colouring matter, using a concentrated strong acid, such as sulphuric acid, as suggested by Soltanpour and Workman (1979).

A second filtration may then be introduced to remove the precipitate, but it is not always sufficiently effective. Centrifuging on the other hand yields a clear, light, yellow-coloured liquid. This colour does not interfere with the blue colour developed during P determination.

The technique proposed here is a routine application of the 'Modified ISFEI method' advocated by van der Merwe (van der Merwe, Johnson, *et al* 1981). In the modified ISFEI method all sodium salts are replaced by ammonium salts.

The total time of analysis is still the same as with present standard procedures. However, only one sample need be weighed and the use of glassware is greatly reduced.

This method is suitable for a high sample through-put and the analysis cost per sample is considerably lower than with present standard procedures (FSSA, 1980).

## Analytical procedure for modified ISFEI

### Extraction :

Weigh 10 g sample into 150 ml Erlenmeyer flask  
Add 100 ml modified ISFEI extractant with daffert pipette  
Shake for 30 minutes at 180 cycles/min (reciprocal)  
Filter through Whatman 42 into 150 ml Erlenmeyer flask

### Analysis :

Analyse by atomic absorption for Ca, Mg, K, Na & Zn or by flame emission for K and Na

### Decolouration :

Pipette use a syringe to measure 5 ml of filtrate into a 100 ml Erlenmeyer flask  
Add (dropper) 4 - 5 drops of conc H<sub>2</sub>SO<sub>4</sub> A.R. (approx 0,1 ml)  
Swirl a few times to promote gas evolution  
Leave approximately 20 minutes to facilitate coagulation of dark material  
Transfer contents to centrifuge tube  
Centrifuge for 3 - 4 minutes at approximately 5000 rpm

### Analysis :

Analyse colorimetrically, supernatant clear liquid for P, Ca and Mg

Samples were analysed three to eight times. In this investigation extracts were analysed as follows:

P colorimetrically by molybdenum blue after decolouration (reducing agent 1, 2, 4 - amino naphthol sulphonic acid)

K and Na by flame emission  
Ca, Mg and Zn by atomic absorption

## Comparative investigation

A total of 42 soil samples, differing widely in available plant nutrient content and other characteristics, have been analysed repeatedly (at least three times) in different batches by two different methods, viz.

- (i) the present standard procedure:
  - Bray No 1 extractant for P (0,025 mol/l HCl and 0,03 mol/l NH<sub>4</sub>F - 1:7,5 extraction ratio)
  - 1 mol/l NH<sub>4</sub>OAc (pH 7) for macro cations (1:10 extraction ratio)
  - EDTA (1:10) or 0,1 mol/l HCl for Zn (1:4 - 1:10 extraction ratio)
 (Analyses by these methods are means of values obtained by this and several other laboratories participating in the FSSA Soil Analysis Check and Control Scheme)
- (ii) modified ISFEI extractant for all the elements [0,1 mol/l NH<sub>4</sub>HCO<sub>3</sub>, 0,01 mol/l NH<sub>4</sub>F and 0,01 mol/l (NH<sub>4</sub>)<sub>2</sub>H<sub>2</sub>EDTA]  
(Extraction ratio, 1:10 soil-mass to volume)

## Summary of results

- (i) Sample range used in the comparative test (values according to present procedure):

	Texture	pH(H <sub>2</sub> O)	OM (%C)	P	K	Ca mg/kg	Mg	Zn
Lowest	sand	4,4	0,01	3	24	200	25	1,3
Highest	sandy clay	8,0	1,7	100	551	2 585	755	11
Number of samples	42	42	42	33	40	38	38	33

- (ii) Linear regression equations and correlation coefficients:

s = present standard procedure (mg/kg)

i = modified ISFEI (mg/kg)

r = correlation coefficient

$$P_i = 2,4 + 0,94 P_s \quad (r = 0,980)$$

$$K_i = 4,3 + 1,07 K_s \quad (r = 0,992)$$

$$Ca_i = -80 + 1,27 Ca_s \quad (r = 0,987)$$

$$Mg_i = 9,4 + 1,22 Mg_s \quad (r = 0,985)$$

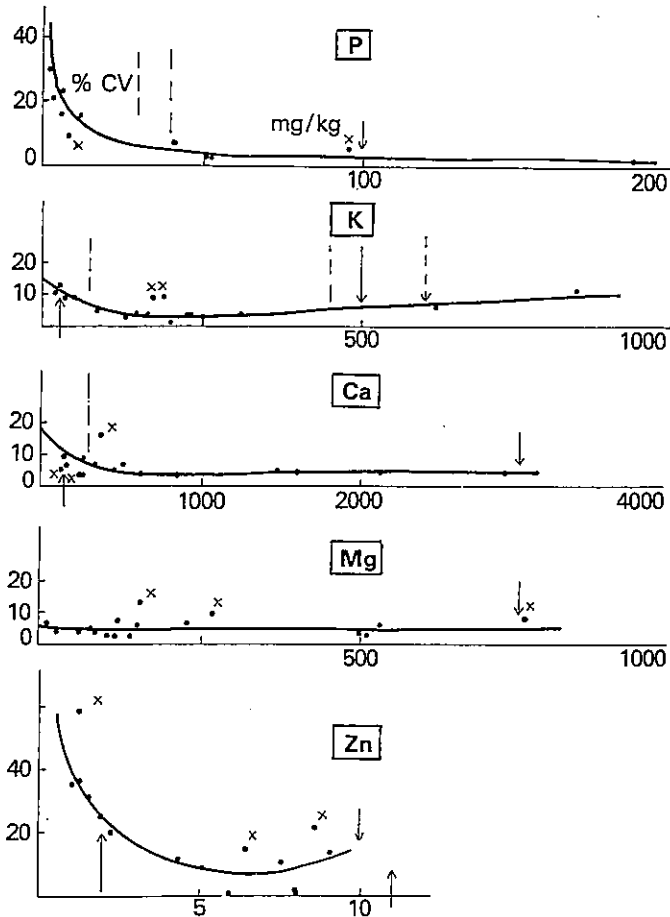
$$Zn_i = 1,1 + 0,77 Zn_s \quad (r = 0,943)$$

(Zn<sub>s</sub> is mean of three different other methods of extraction by six laboratories)

\*ISFEI = International Soil Fertility Evaluation and Improvement

(iii) Precision, modified ISFEI:

Seventeen of the 42 samples were each analysed eight times on different days and standard deviations calculated. The following family of graphs gives the coefficients of variation (% CV) against concentration, for P, K, Ca, Mg and Zn. Most of the Na values were below 25 mg/kg and therefore no correlations of CV were calculated.



Coefficients of variation (% CV) against concentration (mg/kg) for modified ISFEI extractant.

Remarks

- (i) For low Ca values (below 100 mg/kg, standard procedure), ISFEI Ca is very low and erratic. This requires further investigation.
- (ii) CV for K, Ca and Mg are acceptably low. CV's for P < 10 mg/kg, as well as for Zn < 3 mg/kg, are rather on the high side.
- (iii) When soils are alkaline [ $pH(H_2O) > 7,5$ ] and organic matter content is high (>1% C) results are more variable, especially Ca in the high range (>2000 mg/kg).
- (iv) Suitability of colorimetric procedures for Ca and Mg on the modified extract have still to be investigated.

References

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