



The International Fertiliser Society

SOIL AND TISSUE TESTING FOR
MICRONUTRIENT STATUS

W Bussink and E Temminghoff



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by

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SUMMARY.

An adequate supply of micronutrients to crops is necessary to meet optimum crop or animal performance without negative environmental consequences. Therefore quality programmes for soil and plant testing are needed, having good protocols for soil sampling, sample treatment, soil (plant) analysis and interpretation.

Appropriate soil sampling with sufficient sample numbers is crucial to the accuracy and precision of the micronutrient analysis result. Knowledge of the field heterogeneity, the required precision and/or geo-statistics is very helpful in this respect. Great care is needed to prevent contamination during sampling, pre-treatment and chemical analysis. Quality control programmes are necessary in laboratory analysis. The great diversity in soil extractants and extraction procedures results from trial and error research - starting decades ago - using aggressive extractants making it possible to measure anything. The relationships between analytical results and crop response were well tested to develop fertiliser recommendations. However, they have a very local and/or crop specific basis which is a great disadvantage for extrapolation to other situations and for improvement of micronutrient recommendations. However nowadays the development of multi-element techniques as ICP-MS makes low detection limits possible, giving opportunities to move to multi-nutrient extraction with weak electrolytes such as 0.01 M CaCl_2 . Soil chemical concepts using multi-surface models describing the simultaneous adsorption and desorption behaviour of soil components (e.g. clay, oxides, organic matter, CaCO_3) enable the prediction of metal speciation in soil solutions. The free (metal) ion, the form that is taken up by plant roots, can now be measured directly with a new technique, which has a direct relationship with the amount extracted in 0.01 M CaCl_2 . The solid phase properties can probably be measured using mid and near infrared spectroscopy. In this way micronutrient availability is estimated on a fundamental basis, with the advantage that it can be used for different soils types and regions.

Proper plant sampling should take into account the spatial variability in the field, the physiological stage of the crop, the part of the plant to be sampled and the sampling and storing equipment. Total micronutrient amounts are preferably determined by microwave destruction with HNO_3 and H_2O_2 or with HNO_3 , HF and H_2O_2 , because it is fast and gives the best recoveries of total amounts. The digest is analysed with multi-element analysers like SFA, ICP-OES and ICP-MS and sometimes with XRF. Interpretation of plant analysis results is difficult, because it depends on the physiological stage, the supply with macronutrients such as nitrogen and phosphorus, crop species and cultivar, water supply and temperature, which make it difficult to establish exact criteria for critical levels. Plant analysis cannot replace soil analysis, but is a valuable tool in diagnosing micronutrient problems.

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To provide an international forum for discussion and dissemination of knowledge of scientific, technical, environmental, economic and safety aspects of the production, marketing, use and application of fertilisers.

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