



Project Summary

Laboratory Methods for Soil and Foliar Analysis in Long-Term Environmental Monitoring Programs

The principal objective of this methods manual is to present methods for the analysis of soil and plant tissue samples taken as part of a long-term environmental study to evaluate the effects of acid rain on terrestrial systems. Through the use of these standardized methods, it is anticipated that improved data comparability for long-term environmental monitoring programs dealing with acidic precipitation may be achieved. The document contains detailed analytical protocols for the determination of 15 soil and 3 plant tissue parameters with some protocols being applicable to multiple parameters (i.e., the exchangeable cations protocol can be used to quantify Ca, Mg, K, and Na contents in soil). Each chapter contains a brief introduction; review of available methods; selected reference method; summary of the reference method; listing of method interferences and shortcomings; method health and safety concerns; apparatus and equipment list; reagents and consumables list; calibration and standardization procedures; detailed step-by-step procedure; quality control procedures; suggested run format; formulae for the calculation and reporting of the results; and references.

This Project Summary was developed by EPA's National Environmental Research Laboratory, Las Vegas, NV, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

The success of long-term environmental monitoring studies, such as those designed to measure the effects of the long range transport of atmospheric pollutants (e.g., acid rain), will depend on

the type of data collected and the comparability of the data over the course of the monitoring period. Data comparability will depend on collection and analysis procedures as well as the natural spatial and temporal variability of the soil and vegetation. In an effort to ensure/improve data comparability in long-term environmental monitoring programs dealing with acidic precipitation, the U.S. Environmental Protection Agency, Environment Canada, Forestry Canada, and the Ministry of the Environment - Ontario have put together a methods manual for use in Canada and the United States. The objective of this document is to present methods for the analysis of soil and plant tissue samples taken as part of a long-term environmental study to evaluate the effects of acid rain on terrestrial systems.

This methods manual has been prepared for the analysis of soil and foliar plant tissue. Detailed analytical procedures are provided for the following plant tissue parameters:

- Total Nitrogen
- Total Sulphur
- Total P, Mn, Fe, Al, Ca, Mg, and K

In addition, detailed analytical procedures are provided for the following soil parameters:

- Particle-Size Analysis
- Soil pH
- Organic Carbon
- Total Carbon
- Total Nitrogen
- Extractable Phosphorus
- Cation Exchange Capacity
- Exchangeable Cations
- Amorphous Iron and Aluminum Oxides
- Organic Iron and Aluminum

Iron and Aluminum Oxides
Phosphate Extractable Sulphate
Ammonium Chloride Extractable
Sulphate
Water Extractable Sulphate
Total Sulphur

A brief introduction and chapter on *Good Laboratory Practices* are also included in the methods manual.

Each chapter, excluding the introduction and good laboratory practices chapter, provides the user with the following:

- brief introduction to the parameter of interest,
- review of available methods for determination of the parameter of interest,

- reference method for use,
- summary of the reference method,
- listing of method interferences and shortcomings, where applicable,
- method health and safety concerns,
- apparatus and equipment list,
- reagents and consumables list,
- calibration and standardization procedures, where applicable,
- detailed step-by-step procedure,
- quality control (QC) procedures,
- suggested run format showing one possible arrangement of routine and QC samples in a batch,
- formulae for the calculation and reporting of the results, and

- listing of the appropriate references.

The QC procedure section presents information on the determination of precision, accuracy, method blank usage, quality control preparation samples, and quality control check samples.

The U.S. Environmental Protection Agency, through its Office of Research and Development, in conjunction with Environment Canada, the Ministry of the Environment—Ontario, and the Canadian Department of Natural Resources—Great Lakes Forestry Centre, Northern Forestry Centre, and Pacific Forestry Centre have prepared and funded the full report. It has been peer reviewed by the Agency and approved as an EPA publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Brian A. Schumacher and Craig J. Palmer are the EPA Project Officers (see below).

The complete report, entitled "Laboratory Methods for Soil and Foliar Analysis in Long-Term Environmental Monitoring Programs," (Order No. PB95-231007; Cost: \$27.00, subject to change) will be available only from

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