Soil Spectral Library Enabling The Use Of NIR in Analytical Routines

Dr. André Marcelo de Souza
Brazilian Agricultural Research Corporation (EMBRAPA).

Mission is enable research, development and innovative solutions for the sustainability of agriculture for the benefit of Brazilian society.

Our company is spread all over the Brazilian territory.

40 thematic centers such as Embrapa Cotton, Embrapa Grape and Wine, Embrapa Coffee and Embrapa Soil;

Embrapa Soils: Publishes the Official Manual for Soil Analysis in Brazil.
Potential/Year: 8 million of soil analysis

Realized only 3.8 million
MARKET CHALLENGES

- Deadlines
- Skilled labor
- Cost of analysis
- Quality
- Waste management
EVALUATION OF THE POTENTIAL OF NEAR INFRARED SPECTROSCOPY AS A ROUTINE METHOD FOR THE DETERMINATION OF SOIL ORGANIC CARBON
Near Infrared Spectroscopy

12500 - 4000 cm\(^{-1}\) ou 800 – 2500 nm); Overtones and combination bands C-H, N-H, O-H e S-H Wide and overlapping bands

Vibrational Modes
Solids: Diffuse reflectance measurements

- Reflection in the cell
- Specular reflectance in the sample
- Absorption and diffuse reflection in the sample
- Total absorption by the sample
Multivariate chemical data (spectra) can be arranged in the form of a DATA MATRIX.
International Scientific Publications

Soil Organic Carbon analysis

Wet chemistry method by Dichromate Oxidation

Interlaboratorial approach – 120 laboratories;

12 standards soil samples / year

Classification A, B or C;

NIRS methodology

High performance by NIRS - A
SpecLab: Exclusivity for commercial exploitation

Contract Period: 10 years (renewable same period)

Right to use EMBRAPA Technology® brand under royalties
New technology for Soil Analysis

- Analysis in less than 30 seconds
- Reliability of the results (ISO 17025 validation)
- Dismiss chemical reagents that generate toxic waste
- Ease of operation (does not require skilled labour)
- Possibility of implantation in agricultural poles (gains in deadlines & logistics)
- EFFICIENCY, QUALITY & COST REDUCTION
Automated equipment dedicated to soil analysis by VIS-NIR spectroscopy. It has an auto sampler and the capacity to analyse 40 samples per turn.

2000 samples/day

The analytical results are generated through remote access to the cloud-hosted database and automatically published on the SpecSolo® portal.
Why SpecSoil?

Soil Library
1 Million Samples
analyzed by the reference method

Spectral Library
120,000

SpecSoil-Scan®
Automated equipment
to collect spectra

Accurate Results
Technology developed
and validated in
cooperation with
Embrapa Soils

Samples from all Brazilian Regions

Samples from all Brazilian Regions
Visible and near infrared spectroscopy coupled to random forest to quantify some soil quality parameters

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ABSTRACT

This study evaluates the use of visible and near infrared spectroscopy (Vis-NIRS) combined with multivariate regression based on random forest to quantify some quality soil parameters. The parameters analyzed were soil cation exchange capacity (CEC), sum of exchange bases (SB), organic matter (OM), clay and sand present in the soils of several regions of Brazil. Current methods for evaluating these parameters are laborious, timely and require various wet analytical methods that are not adequate for use in precision agriculture, where faster and automatic responses are required. The random forest regression models were statistically better than PLS regression models for CEC, OM, clay and sand, demonstrating resistance to overfitting, attenuating the effect of outlier samples and indicating the most important variables for the model. The methodology demonstrates the potential of the Vis-NIRS as an alternative for determination of CEC, SB, OM, sand and clay, making possible to develop a fast and automatic analytical procedure.

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Pedido nacional de Invenção, Modelo de Utilidade, Certificado de Adição de Invenção e entrada na fase nacional do PCT

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Natureza Patente: 10 - Patente de Invenção (PI)
Título da Invenção ou Modelo de Utilidade (54):
ANÁLISE DE ATRIBUTOS QUÍMICOS E FÍSICOS DE FERTILIDADE DO SOLO POR ESPECTROSCOPIA VIS-NIR PARA USO EM RÓ(255,518),(960,936)
Resumo:
O campo da invenção se volta ao agronegócio, e compreende o fornecimento de um novo método, ou seja, um processo, e respectivo sistema envolvendo produto (hardware + software) no sentido de aprimorar os procedimentos de análises químicas e físicas de fertilidade do solo em rota de larga escala, mediante um pacote tecnológico dedicado à análise de solos, que combina:
- o uso de um espectrofotômetro Vis-NIR, denominado SpecSolo-Scan com respectiva plataforma digital;
- algoritmos químicamente de análise multivariada e;
- um software integrado baseado em nuvem para produzir os resultados analíticos. Para aplicação em rota de fácil manuseio para determinação de atributos químicos e físicos do solo, é necessária a construção dos modelos de calibração para cada um dos atributos que será analisado no solo, associando o resultado da análise via umidade, realizado de acordo com os métodos de referências, com o espectrocorresponderente de cada amostra de solo, adquirida através de espectrofotômetro Vis-NIR da invenção, ou SpecSolo-Scan.

Figura a publicar: 1,2,3
SpecSoil method was pioneer being technically validated by Inmetro (Brazilian National Institute of Metrology, Quality and Technology) for analyses of Organic Matter and Texture (clay, silt and sand) in an ISO 17025 accredited agronomic laboratory.
Video
We are looking for partners at booth 125!

SpecSoil

A combination of great instruments with powerful Data Science with the spectral library at its heat. We are looking for partners in another countries to build a local library and distribute our technology.