

Development and maintenance of a laboratory network using NIR for soil properties assessment in Southern Belgium

Genot Valérie¹, Colinet Gilles¹, Bock Laurent¹, Dardenne Pierre²

¹ University of Liege - Gembloux Agro-Bio Tech – “Soil & Water Systems” Unit
Passage des Déportés, 2, B-5030 Gembloux

² Walloon Agricultural Research Centre - Valorisation of Agricultural Products Department
Chaussée de Namur, 24, B-5030 Gembloux, Belgium – dardenne@cra.wallonie.be



Context

In Walloon Region (Southern Belgium), five routine soil laboratories are grouped within a network promoting a better quality in analysis (www.requasud.be). The harmonization of protocols as well as methodological or technical prospective are realized under scientifically supervision of our research laboratory.

In this context, a study was conducted to evaluate the ability of the NIRS to predict some soil properties: CEC, TOC, TN and clay content (Genot *et al.*, 2011). The initial models were elaborated upon local PLS regression on set of 1 300 soil samples. The local PLS calibration used allows an accurate prediction of the soil properties and precision of NIRS technique is comparable to reference analytical method (Tables 1 & 2).

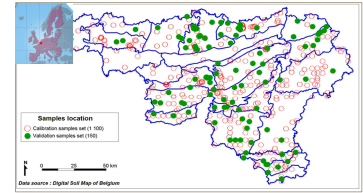


Fig. 2: Location of the calibration and validation sample sets in the various landscape units of Walloon Region.

Table 1: Accuracy of local PLS model based on a decreased r^2 and on a r^2 fixed to 0.99

SEP : root mean square error of prediction
RPD : ratio of prediction to determination

	TOC content (g 100g ⁻¹)	TN content (g kg ⁻¹)	Clay content (%)	CEC (cmol(+) kg ⁻¹)
Range of data base	0.10 – 24.10	0.20 – 11.00	1.5 – 70.6	0.60 – 91.60
Range of validation set	0.10 – 10.40	0.20 – 5.40	1.9 – 54.7	0.80 – 37.00
SEP decreased r^2	0.62	0.66	4.9	3.29
RPD decreased r^2	3.4	2.0	1.7	1.92
SEP fixed r^2 0.99	0.13	0.08	1.82	1.09
RPD fixed r^2 0.99	6.1	2.5	2.6	2.18

Table 2: Results of the repeatability and intra-laboratory reproducibility studies for TOC, TN and clay content, and CEC and weight of standard error of reproducibility in the SEP.

	TOC content (g 100g ⁻¹)	TN content (g kg ⁻¹)	Clay content (%)	CEC (cmol(+) kg ⁻¹)
Repeatability - r	0.11	0.12	2.30	1.22
r%	4.48	4.30	9.71	6.91
Reproducibility - R	0.25	0.20	5.04	2.49
R%	10.59	7.29	21.27	14.14
Part of standard error of Reproducibility in the SEP	1.3%	0.8%	37.1%	24.5%

Transfer soil spectral library

Towards an operational use of the NIRS to predict the CEC, TOC, TN and clay content of Walloon soil samples ...

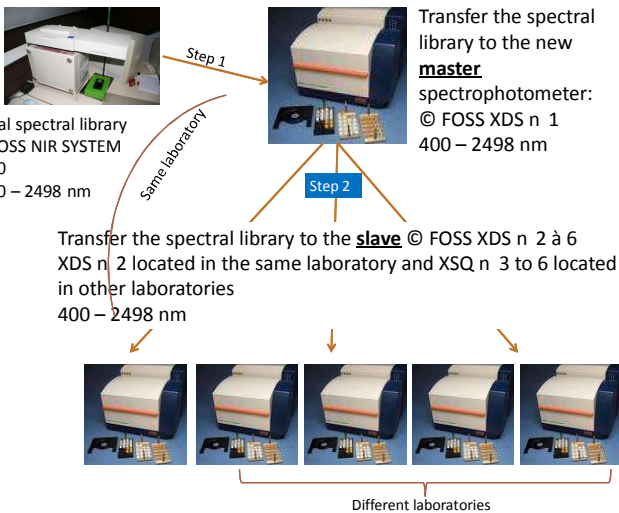


Table 3: Statistics about number of well-predicted samples for the four soil properties

	Land use	TOC content (g 100g ⁻¹)	TN content (g kg ⁻¹)	Clay content (%)	CEC (cmol(+) kg ⁻¹)
Total of scanned samples		3249			
Total of well-predicted samples	Crop	2186	989	298	1199
Percent of predicted samples		76%	20%	7%	43%
Total of scanned samples		1545			
Total of well-predicted samples	Grass Land	975	479	331	597
Percent of predicted samples		67%	29%	19%	41%

Towards a routine used... methodology and results

Step 1 : laboratories scanned the samples and analyzed the samples by reference analysis

Goals :

- Checking the quality of prediction
- Selecting the non-predicted samples and samples different from the spectra database
- Adding the spectra and analytical results in the database
- Improving the prediction accuracy

Step 2 : laboratories scanned the samples

- If prediction is accurate: the predicted value is used in place of analytical one.
- If prediction is not accurate: the sample is analyzed in the lab and both spectrum and reference value are added to the database (Table 3).

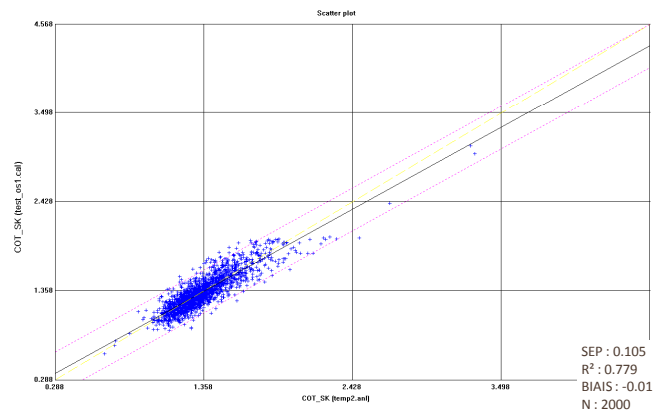


Fig. 3: Results obtained to predict the TOC content of 2000 samples.

Conclusion

This study illustrates the interest of developing soil spectral library in a large, but defined, territory to be used by several laboratories working with the same reference analysis procedure and using a standardized protocol to prepare and scan the soil samples. The models allow an accurate prediction of the four soil properties: total organic carbon, clay and nitrogen content, and cation exchange capacity. NIRS is thus an alternative method in soil analysis, allowing an improvement of fertility advice and precision farming.