

Development of a regional-scale library of near infrared reflectance soil spectra for alternative assessment of soil characteristics in Southern Belgium

Genot Valérie¹, Dardenne Pierre², Bock Laurent¹, Colinet Gilles¹



¹ University of Liege - Gembloux Agro-Bio Tech – “Soil & Water Systems” Unit

Passage des Déportés, 2, B-5030 Gembloux - gilles.colinet@ulg.ac.be

² Walloon Agricultural Research Centre - Valorisation of Agricultural Products Department (Gembloux - Belgium)

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).

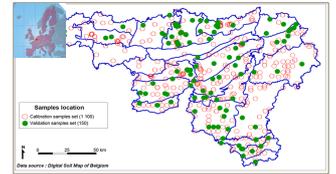


Fig. 2: Location of the calibration and validation sample sets in the various landscape units of Walloon Region.

Table 1: Results of the PLS global and local regression models for the validation sample set

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

Soil properties	N = 60	Global model	Local model	
			Decreased r^2	r^2 fixed at 0.99
TOC (g 100 g ⁻¹)	SEP	0.50	0.20	0.13
	RPD	1.58	3.95	6.08
TN (g kg ⁻¹)	SEP	0.24	0.19	0.08
	RPD	0.83	1.05	2.5
Clay (%)	SEP	4.55	3.8	1.82
	RPD	1.04	1.24	2.60
CEC (cmol ⁺ kg ⁻¹)	SEP	3.03	2.59	1.09
	RPD	0.78	0.92	2.18

Table 2: Results of the repeatability and intra-laboratory reproducibility studies for TOC, T N, clay content, and CEC

Soil properties	sr SPIR	r (%) SPIR	r (%) réf	sR SPIR	R (%) SPIR
TOC (g 100g ⁻¹)	0.001	4.5 %	6.5 % ¹	0.008	10.6 %
TN (g kg ⁻¹)	0.002	4.3 %	7 - 17 % ¹	0.005	7.3 %
Clay (%)	0.83	9.7 %	8.0 % ²	1.82	21.3 %
CEC (cmol(+) kg ⁻¹)	0.19	6.9 %	8.0 % ²	0.81	14.1 %

Transfer soil spectral library

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

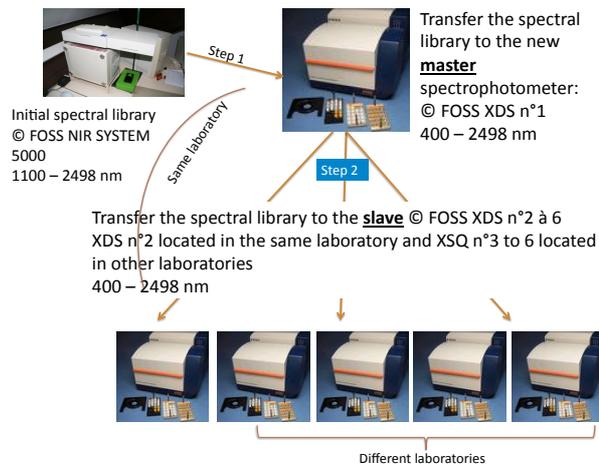


Table 3: Statistics of predicted samples in the network

Parameters	OS	TOC (g 100g ⁻¹)	NT (g kg ⁻¹)	Clay (%)	CEC (cmol(+) kg ⁻¹)
Total samples	Crop	3249			
Samples predicted		2186	989	298	1199
% of pred. samples		76 %	20 %	7 %	43 %
Total samples	Grassland	1545			
Samples predicted		975	479	331	597
% of pred. 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).

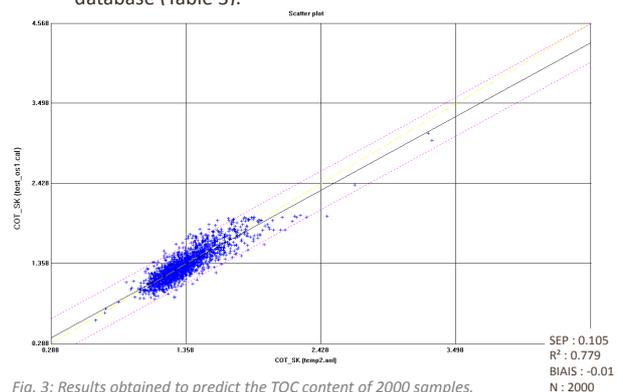


Fig. 3: Results obtained to predict the TOC content of 2000 samples.

Conclusion

The main conclusions of our study are:

- Building a soil spectral library is time consuming and expensive, but ...
- The models allow an accurate prediction of the four soil properties
- Once the models elaborated, 120 samples can be scanned in one day on one NIR spectrophotometer
- NIRS is an alternative method in soil analysis, allowing an improvement of fertility advice and precision farming.

Genot V., Colinet G., Bock L., Vanvyve D., Reusen Y., Dardenne P., 2011. Near infrared reflectance spectroscopy for estimating soil characteristics valuable in the diagnosis of soil fertility. *J. Near Infrared Spectroscopy*, **19**, 117-138

