VARIATIONS OF SOIL ATTRIBUTES IN VINEYARDS INFLUENCE THEIR REFLECTANCE SPECTRA

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Abstract

Reflectance measurements were performed on soils of two vineyards, on different geological formations, same management. **Objective was to detect spectral differences between the areas due differences in soils**. Soil samples were collected from ten vine parcels and concentrations of 21 soil attributes measured. Soil spectroradiometry was done. Chemical differences significant to a 95% confidence level between the two areas were found for six soil attributes, and the reflectance spectra were separated at this same level. For ten soil traits there were wavelength domains where reflectance and concentrations were correlated to levels from 95% to 99%. Partial Least Squares Regression (PLSR) compared measured and predicted concentrations, and for fifteen of 21 soil traits we found Pearson correlation coefficients *r* > 0.8. As conclusion, variations on concentration in soils induce differences in reflectance that can be detected by spectroradiometry, to be applied to the assessment of chemical content of soils as a fast, low-cost alternative to chemical analytical methods.

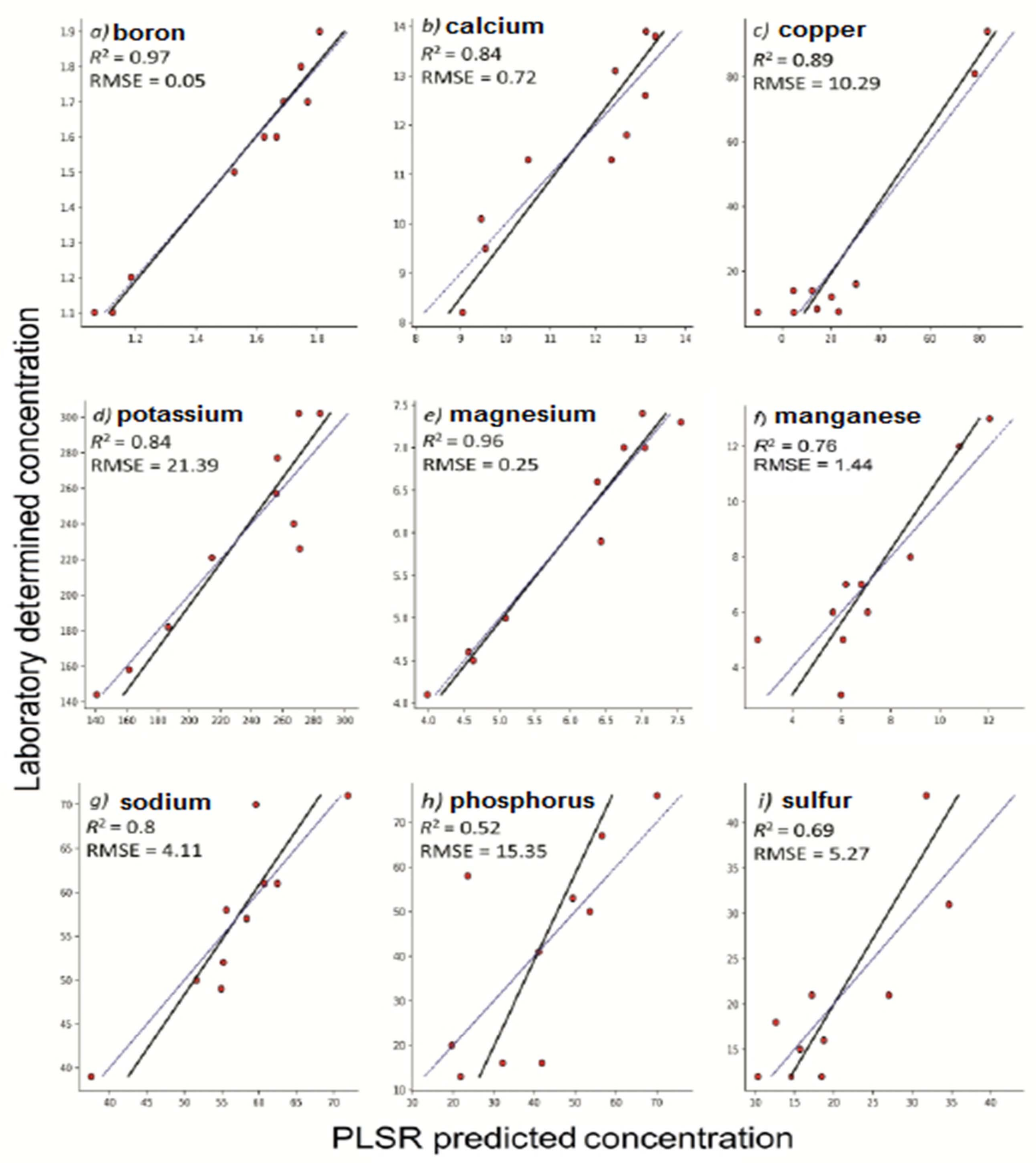

Figure 2. Predicted concentrations from PLSR (Partial Least-Squares Regression) of selected soil attributes.

Study area

Vine parcels at Boscato Winery in south Brazil, with 5.38 and 7.93 hectares, 2 km apart and with the same management, being assumed that differences between soils are intrinsic and not anthropic.

Measurements

Soil reflectance of 10 parcels measured with FieldSpec 3 radiometer, spectral sensitivity range from 350 to 2500 nm.
Concentrations on soils of P, K, Cu, Zn, Na, Ca, Mg, Mn, B, Fe, S, clay, pH, H+Al, SMP, OM, CEC, and CEC/BS.

Results

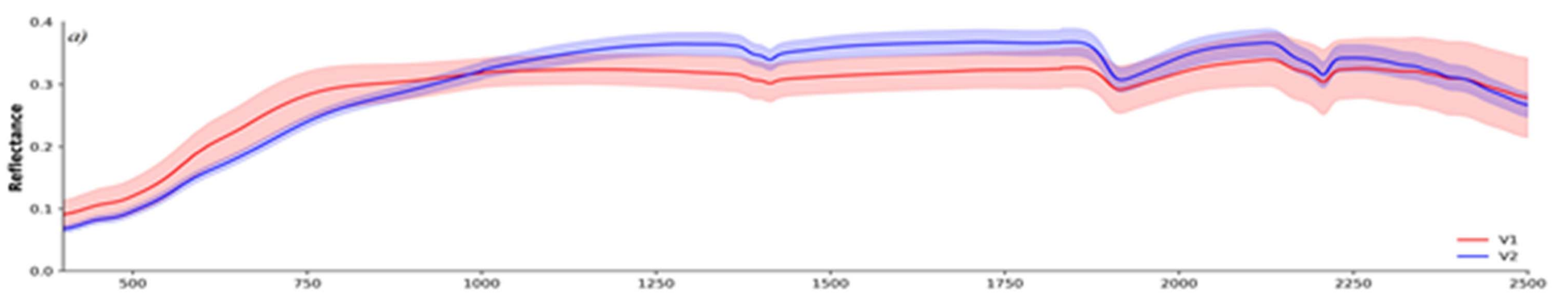

Figure 1. Average reflectance of Vineyards 1 and 2 with 95% confidence level, showing spectral separation between vineyards.

Table 1. Wavelength domains for the most significant correlations between chemical concentrations and reflectance for soils of all ten vine parcels. *λ* is wavelength in nm; *r* is Pearson correlation coefficient; * after *r* values refers to OneWay test, p-value < 0.01; ** p-value < 0.05

	Wavelengths 1		Wavelengths 2		Wavelengths 3		Wavelengths 4		Wavelengths 5	
Attribute	λ	r	λ	r	λ	r	λ	r	λ	r
B	400 to 588	-0.74**	589 to 787	-0.78*	788 to 863	-0.73**	1191 to 1893	+0.72**		
Ca	400 to 770	-0.81*	791 to 869	-0.74**	1278 to 1871	+0.67**				
Fe	400 to 618	-0.75**	619 to 626	-0.77*	627 to 832	-0.75**	1241 to 1407	+0.65**	1418 to 1745	+0.64**
K	405 to 418	-0.77*	419 to 603	-0.75**	604 to 725	-0.78*	1215 to 1609	+0.79*	1610 to 1876	+0.75**
Mg	400 to 831	-0.81*	832 to 897	-0.76**						
Mg/K	1032 to 1116	-0.65**								
CEC	400 to 823	-0.84*	824 to 874	-0.74**	1108 to 1197	+0.76**	1198 to 1830	+0.81*	1831 to 1888	+0.72**
OM	400 to 813	-0.75**	1068 to 1164	-0.76**	1165 to 1861	+0.82*	1862 to 1896	+0.76**	1999 to 2140	+0.66**
H+Al	1050 to 1290	+0.63**								
SMP	1072 to 1362	-0.67**								

Conclusions

Applications of these observations and methodology include the assessment of the chemical content of soils by spectroradiometry as a fast, low-cost alternative to chemical analytical methods.