SPECTRAL FEATURES OF VINE LEAVES ARE INFLUENCED BY THEIR MINERAL CONTENT

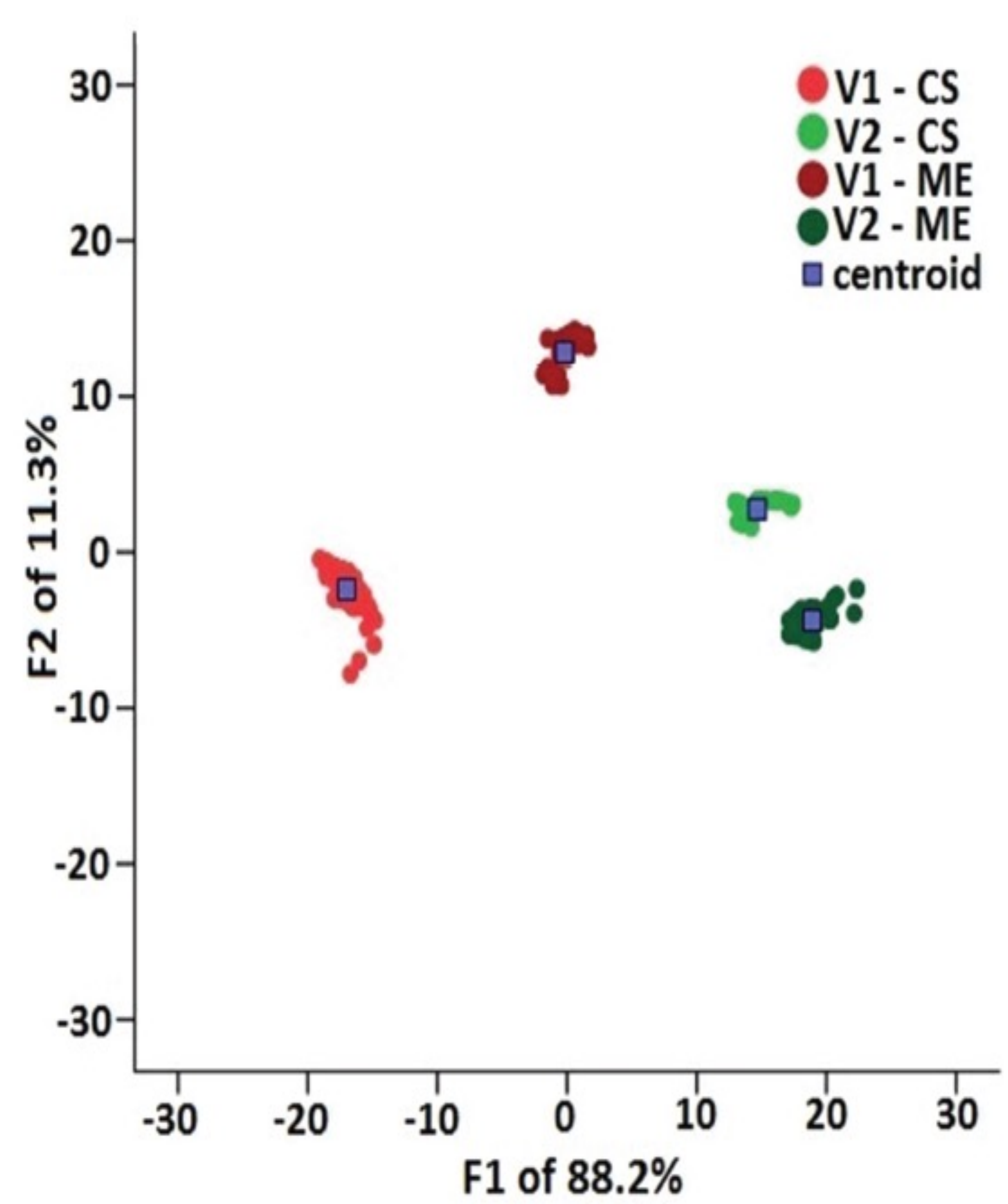
Adriane B. Thum[1,2] , Diniz C. Arruda[2] and Jorge R. Ducati[2]

[1]Escola Politécnica, Universidade do Vale do Rio dos Sinos, São Leopoldo, Brazil.

[2]Centro Estadual de Pesquisas em Sensoriamento Remoto e Meteorologia, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

Abstract

We report results from reflectance measurements on leaves and branches of Merlot and Cabernet Sauvignon in two vineyards with different geological origins but same management, aiming to detect spectral differences between the vineyards, correlated to variations in the chemical content of eleven elements in vine leaves. Seven vine parcels were selected. Discriminant analysis applied to reflectance data of leaves and branches and to grape varieties allowed for good separation between vineyards and varieties (> 90% accuracy). Correlations between leaf chemical composition and reflectance were found for several wavelengths with Pearson correlation coefficients $r > 0.7$. Elemental concentrations could be modelled up to 94% accuracy. These results suggest that variations in soil properties induce chemical differences in vine leaves that can be detected by reflectance measurements. Applications include the assessment of the chemical content of vine leaves by spectroradiometry as a fast, low-cost alternative to chemical analytical methods.



Discriminant analysis of branch reflectance data. V1, Vineyard 1; V2, Vineyard 2; CS, Cabernet Sauvignon; ME, Merlot.

Figure 2. Using discriminant analysis we were able to separate branches by place and variety.

Study area

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

Leaf reflectance of 7 parcels measured with FieldSpec 3 radiometer, spectral sensitivity range from 350 to 2500 nm.

Chemical concentrations in leaves of eleven elements were also measured (N, P, K, Ca, Mg, S, Cu, Zn, Fe, Mn and B).

Results

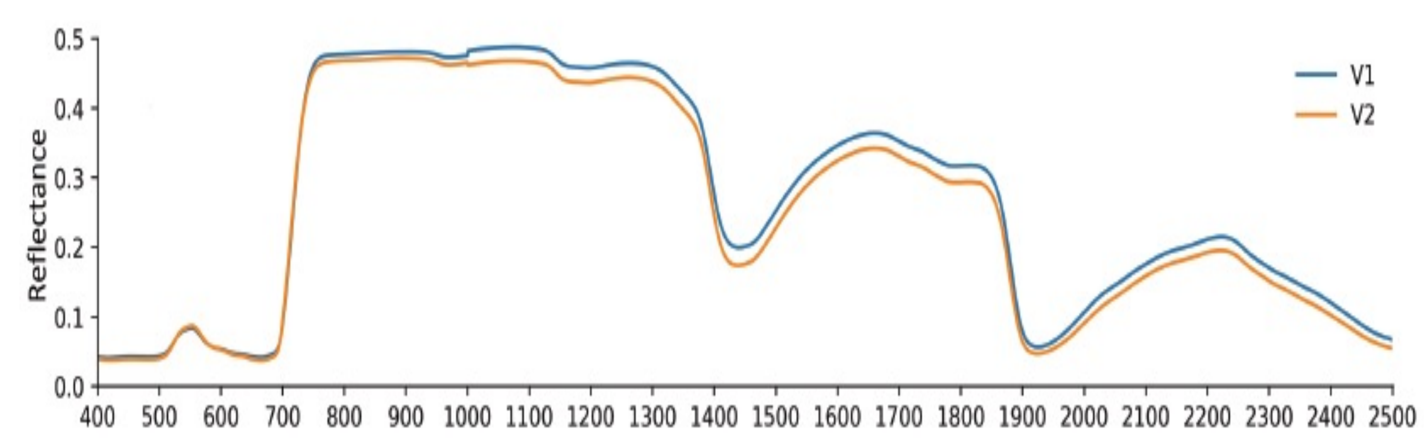


Figure 1. Average reflectance of Vineyards 1 and 2, showing spectral separation between vineyards.

Table 2. Wavelengths with higher correlations between reflectance and chemical concentration in vine leaves. λ is wavelength; r is the Pearson correlation coefficient. Wavelengths in bold characters are exclusive of their respective elements.

	Wavelength 1		Wavelength 2		Wavelength 3		Wavelength 4		Wavelength 5	
Element	λ (nm)	r	λ (nm)	r	λ (nm)	r	λ (nm)	r	λ (nm)	r
P	1040	−0.81	1102	−0.82	**1516**	0.75	**1947**	0.76	**2047**	0.75
K	513	0.82	649	0.77	693	0.69	1361	−0.71		
Ca	1035	−0.86	**1209**	−0.84	1422	0.87	1908	0.91	2017	0.91
Mg	515	0.58	642	0.83	693	0.55	1360	−0.50	**1654**	−0.57
S	761	−0.75	**1013**	−0.87	1414	0.87	1916	0.89	2012	0.91
Cu	**540**	−0.82	746	−0.77	**1154**	−0.79	1307	−0.78	**2129**	0.78
Zn	**529**	−0.91	696	−0.87	**1574**	0.89	**1806**	0.84		
Fe	517	−0.56	649	−0.77	692	−0.78	1105	−0.54		
Mn	748	−0.95	1048	−0.92	**1139**	−0.91	**2108**	0.95		
B	**781**	−0.84	**1167**	−0.82	1305	−0.85	**2160**	0.81		
N	697	0.81	**998**	0.80	**1436**	−0.77	**2411**	−0.78		

Conclusions

Variations in soil properties induce chemical differences in vine leaves that can be detected by reflectance measurements.

Applications include the assessment of the chemical content of vine leaves by spectroradiometry as a fast, low-cost alternative to chemical analytical methods.