

REMOTE SENSING TECHNIQUES IN THE CHARACTERIZATION OF VITICULTURAL TERROIRS IN SOUTH BRAZIL: A CASE STUDY ON MALVASIA

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Abstract

Malvasia grapes have been cultivated in south Brazil since about 1930. Early local vineyards of this variety were given the vague attribute “Malvasia”, a generalization which later became more precise. Present vineyard area is over 110 hectares, of varieties Bianca, Candia, Chianti, Istriana. Rootstocks are mainly SO4, Paulsen 1103, Kober 5BB, and the locally developed Solferino. Subtropical climate favors bunch rot at more humid summers. Regional production between 2005 and 2007 was about 800 metric tons per year. Grapes enter in the blending of sparkling wines, or in monovarietal dry or off-dry whites, being presently produced by several wineries. This article gives a panorama of the main producing regions, at the Serra Gaúcha and the Campanha, including terroir characterization through field studies and remote sensing satellite imaging. Features on relief, solar exposition and climate are given, along with geological and soil descriptions. A profile of products at some wineries follows, and correlations with their terroir are looked for. Finally, dry and dessert wines from micro-vinifications of Malvasia at Reliquie Vini winery are presented.

Keywords: remote sensing; satellite images; microvinification

Area temática: viticultura

1. Introduction.

Viticulture in South Brazil was greatly expanded after the arrival of Italian colonists around 1875. These immigrants brought vines of *vinifera* varieties, which rapidly succumbed to fungal diseases typical of the Americas. The solution was a massive reconversion to American grapes, which still today make most of the bulk production of table wines. However, around 1930 *viniferas* started to be grown again, a development due both to local market demands and to better techniques to control diseases. Presently, grape production in Rio Grande do Sul State makes most of Brazilian output (in 2006, 624,000 metric tons out of 1,228,000 nationwide; Mello 2007). Grapes of *vinifera* varieties make about 25% of this production.

The region occupied by Italian immigrants is called the Serra Gaúcha, thanks to the steep slopes of its relief. It is located to the north-east of the State's capital, Porto Alegre. After more than one century, the landscape is culturally molded, and the old pergola vineyards are a cultural heritage (Oliveira and Ducati 2008; Figure 1) which qualifies as a viticultural *terroir* (Oliveira et al. 2007).

Malvasia grapes have been grown at the Serra Gaúcha since about 1930, being the source of dry and, mostly, dessert wines already locally famous in the 60's (Figure 2); having received at this starting point the vague denomination "Malvasia", later vineyards came with more defined cultivars like Bianca, Candia, Chianti, Istriana. Present vineyard area is over 110 hectares. Rootstocks are mainly SO4, Paulsen 1103, Kober 5BB, and the locally developed Solferino. Subtropical climate favors bunch rot at more humid summers. Regional production between 2005 and 2007 was about 800 metric tons per year. However, the regional climate tends to have humid summers which favor grape rot, alternating good and bad years; a sustained production of high-quality wines is possible only through careful bunch and berry selection, forcibly leading to small annual bottling. An example of such winemaking is given at the end of this paper.

Research on new viticultural regions in South Brazil has been launched in the 60's. Among the pioneer initiatives, the one that presently deserves to be mentioned is the investigation by the late agronomist Onofre Pimentel for the Companhia Vinícola

Rio-Grandense, which was at the time (1976) one of the largest in the State. The region was the smooth hills to the south of Porto Alegre, near the town of Pinheiro Machado. In this region, called the “Serra do Sudeste”, climate is drier, especially at late summer. Many vinifera varieties have been tested, like Cabernet Sauvignon and Merlot, but the success of Cabernet Franc and Malvasia was noted. Presently several wineries are producing quality wines at the zone, and new investments are under consideration. Careful planning is therefore needed, and modern techniques for territorial studies are of great help. In this respect, it was demonstrated (Vaudour 2002) that satellite images can be used to terroir studies. Spectral analysis of multiband images was operative even at the level of variety recognition (Cemin and Ducati 2008; Silva and Ducati 2009), while digital elevation models are useful to indicate adequate slopes. This paper reports some results from the use of Remote Sensing techniques to terroir characterization of the region.

2. Regional appellations in south Brazil

The effort to establish regional appellations for Brazilian wines was first successful at the Vale dos Vinhedos, in Rio Grande do Sul State (Falcade and Mandelli 1999). Other initiatives followed, and presently files have been filled and are under consideration at the competent federal offices, including for the “Mountain Wines” at Pinto Bandeira, for which Remote Sensing is being extensively used (Coutinho et al. 2008). Most studies have the fundamental participation of the Brazilian agency for agricultural research, EMBRAPA (Empresa Brasileira de Pesquisa Agropecuária) through its station for grape and wine research, the CNPUV (Centro Nacional de Pesquisas em Uva e Vinho), based in Bento Gonçalves, at the heart of the wine producing region. In this respect, geotechnologies have been used in terroir characterization, including in the above mentioned Serra do Sudeste (Flores et al. 2007; Hoff et al. 2008) around Pinheiro Machado.

The Serra do Sudeste new viticultural region is rapidly expanding, its relief being adequate to vinegrowing (Figure 3). From 1995 to 2007, vineyard area augmented threefold (Mello and Machado 2008). Experiments with many vinifera cultivars are

under way (Table 1), where it is noted that Malvasia is the most grown white grape, surpassing even the international cultivar Chardonnay.

3. Material and methods

The Pinheiro Machado region is located in south Brazil, as shown in Figure 4. All cartography in this study was based in the Brazilian Army map SH.22-Y-C-V-1, at the scale 1:50,000, at latitudes $-31^{\circ} 30'$ to $-31^{\circ} 45'$ and longitudes $-53^{\circ} 15'$ to $-53^{\circ} 30'$. Thematic data, as well as on geomorphology and soils, at 1:250,000 scale (IBGE 2003), and geological at 1:1,000,000 (Ramgrab 204) were projected in the region's map, being georeferenced and put in the Geocentrical Reference System for the Americas (SIRGAS 2000) (IBGE 1997).

Data on relief came from the Digital Elevation Models (DEM) generated by the Shuttle Radar Topographic Mission (SRTM 2003) with 90 meters resolution. These were used to obtain the hypsometry at 100 meters steps and to define an area above 400 meters. Terrain slopes, as well as orientation of solar exposition were looked for and both information combined to define the better areas to viticulture.

4. Results

The relief in gray shades is shown in Figure 5a from an azimuth of 45° North and solar elevation of 45° . Over this basis, information on soils, geomorphology and litostratigraphy are superimposed.

The DEM in Figure 6a is crossed separately with data on slopes and solar orientation in parts b and c, and combined in Fig. 6d.

In Figure 7a areas above 400m are indicated, and in Fig. 7b, data on slopes and illumination are combined for these altitudes. This information crossing produces the shades characterizing the better conditions for viticulture, from the criteria of altitude, slope, and illumination. Areas are classified as excellent, acceptable, and non-recommended.

In Figures 8a to d, area classification is superimposed with the information given in Figures 5 on geomorphology, soils and lithostratigraphy, as support in decision processes concerning specific viticultural needs.

4. A case study on Malvasia vineyards and production

It's well known that Malvasia is sensitive to diseases such as mildew and rot, and vineyard localization is crucial to plant and grape sanity. In this respect, existing vineyards in Pinheiro Machado enjoy favourable conditions, as attested by the enduring production of good dry and sparkling Malvasia wines by the Terrasul winery since over twenty years, in its property situated in the zone classified as "excellent" in this study. Malvasia vines, there, cover an area of 11 hectares. Winemaking follows the standard procedures for this production scale, and wines are marketed in the usual way.

A quite different case is the one of the artisanal production of Malvasia and other wines by Reliquiæ Vini in Garibaldi, in the core of the Serra Gaúcha region. As already mentioned, bad years alternate with better ones. As a matter of fact, in the last 11 years, "good years" were 1999, 2000, 2002, 2004, and 2005; as "reasonable" one could cite 2006, 2007 and 2008; and as "bad" vintages, 2001, 2003, and worst of all, 2009. These data are especially valid for the Serra Gaúcha, as for other micro-regions in the State, local conditions can be different (as it was the case for the good 2009 vintage at the property of the first author of this paper). Facing such conditions, maintaining quality is quite a challenge, and the way found by Reliquiæ Vini was to concentrate in small batches, where the few plants of each grape variety could be closely managed. For Malvasia, about 200 vines in pergola training (to keep canopy as far as possible from soil humidity; Figure 9) produce an average of 700 kg per year. After being crushed by feet, skins are immediately separated and fermentation takes place at 12° C to 14° C for 30 days. Resulting wines (dry and sweet) are directed to a specific consumer profile.

5. Concluding remarks

The two markedly different production modes described in the preceding section are, to be sure, repeated for many others grape varieties as, simultaneously, large corporate, and small, proprietary wineries blossom all over the State. In this respect, investments from the first kind of entrepreneurs are obviously much larger, and territorial studies like the one presently described are crucial to maintain perspectives of economical viability. The joint use of Remote Sensing techniques, data from satellite images, meteorological records, and territorial (soil, relief, morphology) surveys proves to be relevant to sustainable viticulture.

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FIGURES AND TABLES



Figure 1. Typical viticultural landscape at the Serra Gaúcha, Brazil, region of Italian colonization.



Figure 3. Typical viticultural landscapes near Pinheiro Machado, at Serra do Sudeste, Brazil



Figure 4. Location of the Pinheiro Machado region.

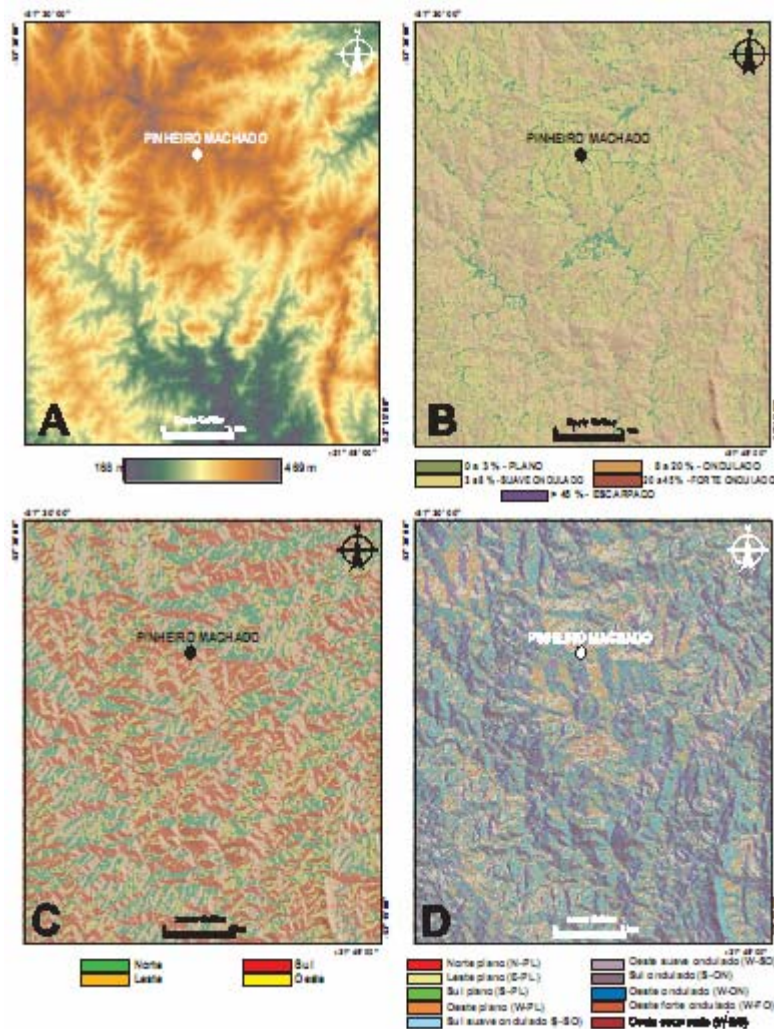


Figure 6. Area of interest. a) digital elevation model; b) map of slopes; c) map of solar orientations; d) combination of slopes and solar orientations.

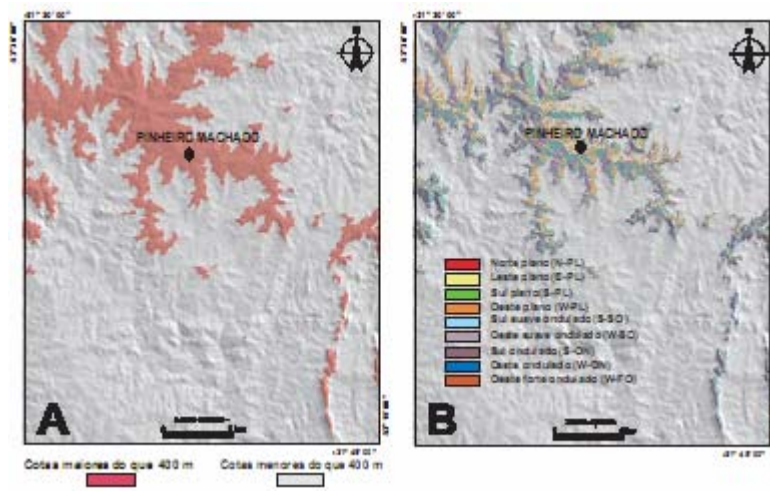


Figure 7. Area of interest. a) hypsometry of areas above 400m; b) projection of slopes and solar orientations over area in a).



Figure 9. Malvasia in pergola training at Reliquiæ Vini, Summer 2009. Grapes were under attack by rot in this poor year.

Cultivar	Área(ha)	Nº plantas(1000)	Produção(t)	Porcentagem (%)
Merlot	16.05	49.12	95.89	29.27
Malvasia de Cândia	11.22	27.25	77.78	23.70
Cabernet Sauvignon	28	87.36	57.71	17.58
Chardonnay	7.83	26.4	21.82	6.65
Touriga Nacional	3.39	11.71	18.91	5.76
Cabernet Franc	13.24	45.78	16.35	4.98
Sauvignon Blanc	2.29	6.56	13.59	4.14
Petite Syrah	1.62	5.36	8.28	2.52
Gamay Beaujolais	2.08	6.28	7.7	2.35
Riesling Itália	2.3	10.16	4.4	1.34
Gouveio	2.2	7.72	1.67	0.51
Caladoc	0.18	0.63	1.1	0.33
Dornfelder	0.26	0.9	1.05	0.32
BRS Lorena	0.05	0.17	0.7	0.21
Itália	0.05	0.16	0.46	0.141
Tempranillo	1.69	5.93	0.45	0.137
Castelão	0.04	0.15	0.35	0.11
Alicante Bouschet	0.22	0.78	0	0
Ancellotta	0.18	0.59	0	0
Pinot Noir	0.15	0.48	0	0
Tannat	1.58	5.25	0	0
Tinta Barroca	0.05	0.18	0	0
Tinta Caiada	0.04	0.15	0	0
TOTAIS	95.33	301.2	328.21	100

Fonte: Cadastro Vitícola do Rio Grande do Sul - 2005 a 2007 (Mello e Machado, 2008).

Table1. Production of grape varieties in Pinheiro Machado region.