PROPOSAL OF ZONIFICATION AND CHARACTERIZATION OF TERROIRS IN THE YALDE-NAJERILLA-URUÑUELA VINE GROWING AREA (DOC RIOJA, SPAIN), BASED ON THE SOIL INFLUENCE.

E. García-Escudero[1], J. Mª. Martínez[1], E. P. Pérez[1], R. López[1] and I. Martín[1]
[1]Servicio de Investigación y Desarrollo Tecnológico Agroalimentario (SIDTA-CIDA)-ICVV.
Ctra. Logroño-Mendavia NA-134 Km. 90. 26071 Logroño, La Rioja. (Spain).
e-mail: sisrsuelos.cida@larioja.org, Tfno:+36-941291833

ABSTRACT

Natural Terroir Units (NTU) are being delimited in vine growing area DOCa Rioja, in collaboration with Uruñuela Cooperative, to characterized specific and singular Tempranillo (*Vitis vinifera, L.*) wines. NTU selection is based on detailed cartography (1:20.000), managed by the Soil Information System of La Rioja (SISR), and in the analysis of pedologic, climatic, lithologic, and relief features of Najerilla Valley.

The five NTU, placed on river and torrential platforms with similar lithology of original materials, have been selected with series of soils belong to the Alfisol, Inceptisol and Mollisol orders. The main purpose of this project is to measure the influence produced by soil properties of each series of soil (effective depth, water reserve, clay and carbonates percentage, potassium and magnesium) in musts and wines of this vine growing area.

KEY-WORDS

Terroir – soil – Tempranillo – grapevine - wine

INTRODUCTION

Terroir can be defined as an interactive ecosystem, in a given place, including climate, soil, and the vine (rootstock and cultivar), (Seguin G.,1988; Van Leeuwen C. *et al.*, 2006). The effect of climate was greatest on most parameters, followed by soil and cultivar. (Van Leeuwen *et al*., 2004).

As part of the characterization of wine terroirs, a proposal for the establishment of possible relationships between natural factors, especially soil, and the physico-chemical and organoleptic characteristics of wines made with Tempranillo (*Vitis vinifera*, L.) in the Uruñuela environment (La Rioja, Spain) is put forward. This municipality, with a vineyard area of 1,200 ha, is located in the lower Najerilla riverine, whose soils are gravels, cobbles and stones materials originating in parent silty-sand and sand matrix. The main pedogenetic processes relate partial translocation of carbonates and clay illuviation. The surface was modeled on the Neogene geological materials of Najera formation. Those original materials are covered with Quaternary deposits from the river (terrace) and torrential (alluvial fan and glacis) modeling.

The primary landforms are slopes and platforms, with altitudes ranging from 440 to 583 m.s.l., as a result of an intense water modeling.

The area is characterized by a dry Mediterranean climate, with semi-arid tendency, and a strong daily, monthly, seasonal and annual thermal oscillation. As a unit climate can be classified as temperate mesomediterranean (Papadakis). The average values of annual precipitation and temperature are 436 mm and 13.2 ºC respectively.

Different areas, defined as Natural Terroir Units (NTU) (Carey *et al*., 2008), were delimited. The selection of NTUs was based on detailed mapping (1:20,000) which manages the Soil Information System of La Rioja (SISR), defining for the area 29 series and 23 map units (Soil Surface Staff, 2006). The climatic, soil, lithology and relief of the lower Najerilla riverine are also taken into account.

MATERIALS AND METHODS

Based on their distribution and importance (Fig. 1), we considered five NTUs. In each of the NTUs three representative vineyards were chosen (Fig. 2 and Tab. 1). To reduce variability attributable to variety for farm management factors, the study was focused on the Tempranillo variety, grafted on Richter 110 rootstock. The vineyards were in full production, with an age ranging from 10 to 25 years, and an average planting density 3,000 plants/ ha, with a deviation of ± 200. According to the characteristics of each NTU, the vineyard was trellised in VSP ("espalier") (Royat double cordon system) or bush vines ("gobelet").

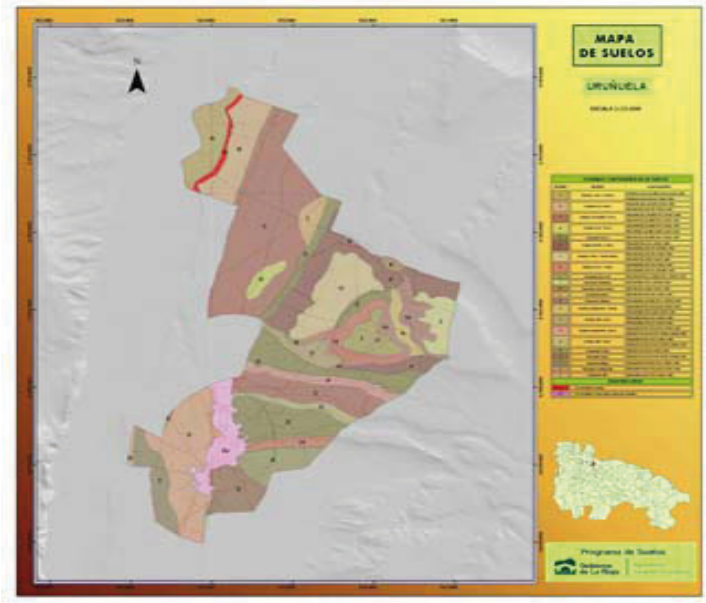


Fig. 1. Soil mapping (1:20.000) of Uruñuela (DOCa Rioja-Spain).

In each plot, a "sampling unit" was bounded in which all surveys and measures were conducted. Monitored parameters were:

- **Vineyard nutritional status**. Mineral composition (macro and micro-elements) of leaf blades and petioles sampled at veraison. (García-Escudero E. *et al*., 2006).
- **Yield components, vigour indicators and vegetative-productive plant balance.** At harvest, grape yield, cluster number, average berry and cluster weight per vine were measured. Wood pruning per vine, shoot weight and Ravaz Index were assessed at post harvest.
- **Ripening process**. **Winemaking.** To determine the optimal date of harvest, sugar concentration (probable degree), acidity and colour components were monitored in musts during maturation on a weekly basis. For each plot a sample or 150 kg was harvested and then elaborated in 100 l. stainless steel vats. The alcoholic fermentation was conducted with active dry yeasts, at room temperature. Malolactic fermentation was induced by commercial lactic bacteria inoculation. Thus, fifteen wines were elaborated, from the experimental vineyards (three plots per NTU), in which pH, titratable acidity, tartaric acid, potassium,

alcoholic degree, colour intensity, tonality, total phenolic index and anthocyanins were determined. Wines were blindly tasted.

- **Weather data.** Climatic data were measured in the close vicinity with an automatic weather station (coordinates (zone 30) UTM X: 523,622, UTM Y: 4,701,100 and altitude: 465 m) management by Agroclimatic Information Service of La Rioja (SIAR).

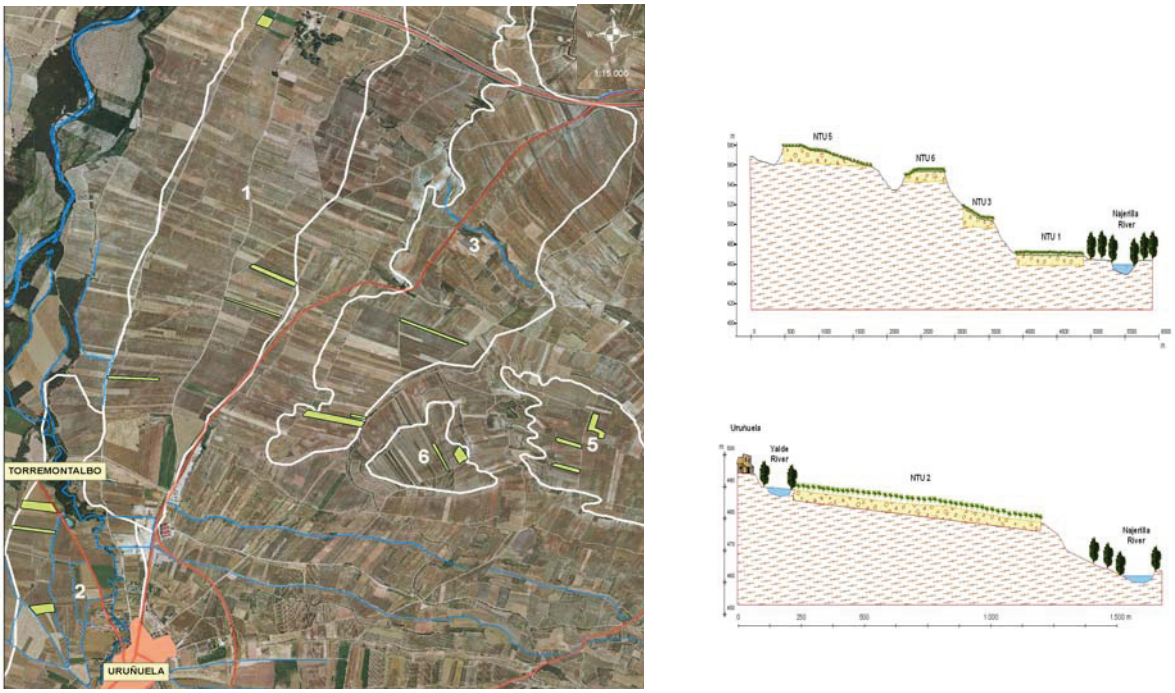
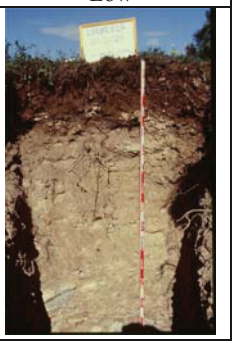


Fig. 2. Map and topographic section across of selectioned plots in the delimited NTUs

Tab.1. Soil characteristics and representative soil profiles of Natural Terroir Units (NTUs).

	NTU 1	**NTU 2**	**NTU 3**	**NTU 5**	**NTU 6**
Classification (Soil Taxonomy, 2006)	*Calcic Haploxeralfs, loamy-skeletal, mixed, mesic*	*Fluventic Haploxerepts, loamy, mixed, mesic*	*Calcic Palexeralfs, clayey, mixed, mesic*	*Typic Calcixerepts, loamy-skeletal, carbonatic, mesic*	*Petrocalcic Palexerolls, loamy-skeletal, carbonatic, mesic*
Landscape unit	Terrace II Najerilla river	Alluvial depth Yalde river	Terrace III Najerilla river	Glacis IV	Terrace IV Najerilla river
Parent materials	Gravels and cobbles in sand matrix	Sands, silts and clays	Gravels and cobbles in sand matrix	Gravels and cobbles in sandy loam matrix	Gravels and cobbles in sand matrix
Rock fragments (%)	40-80	5-10	15-40	15-40	40-80
Effective depth (cm)	110	150	90	115	50
Clay (%)	17-30	24-25	45-55	15	20
Carbonates (%)	3.5-5	3-7.5	40-50	45-60	55
Water availability	Low	Moderate-high	Moderate-high	Moderate-low	Low
Representative soil profile					

- **Statistical analysis.** Treatment effects on measured variables were tested using ANOVA (univariate linear model), and comparisons among treatment means were made using the Tukey´s test calculated at $p < 0.05$.

RESULTS AND DISCUSSION

We present 2009 campaign results respect to mineral composition of leaves (Tab. 2), yield components (Tab. 3), physical-chemical parameters of wines produced (Tab. 4 and Tab. 5). In a preliminary assessment, the results show clear differences for the NTU 2. This NTU, corresponds to a Yalde river flood plain, with high soil fertility and elevate effective depth, presented the highest values of yield and vigour. Also, the physical-chemical analysis of wines in the NTU 2 reached the lowest alcoholic degree and colour parameters (anthocyanins, colour intensity and total polyphenols). Components of the acidity in NTU 2 wine showed the lowest tartaric acid and the highest potassium concentrations, which contributed to the increase of wine pH. In NTU 2 must, potassium highest levels were observed, this was in accordance with the potassium concentration in both leaf blade and petiole. In the blind tasting panel the NTU 2 wine had the lowest score (data not shown).

Tab. 2. Principal mineral composition of leaf blades and petioles (% dry matter), at veraison. Uruñuela 2009.

Leaf tissue	NTU	N	P	K	Ca	Mg
Leaf blade	1	2.15 **ab**	0.15	0.66 **b**	2.82	0.31
	2	2.47 **a**	0.19	1.02 **a**	3.23	0.28
	3	2.08 **ab**	0.16	0.68 **b**	3.11	0.38
	5	2.18 **ab**	0.21	0.56 **b**	2.96	0.33
	6	2.04 **b**	0.15	0.60 **b**	3.24	0.32
Petiole	1	0.46	0.16	0.65 **b**	1.66	0.66
	2	0.52	0.22	1.90 **a**	1.89	0.53
	3	0.43	0.14	0.65 **b**	1.64	0.76
	5	0.46	0.25	0.57 **b**	1.97	0.74
	6	0.42	0.20	0.64 **b**	2.27	0.77

Different letters in same column indicate significant differences ($p<0.05$) in leaf analysis data between NTUs, applying Tukey´s test.

Tab. 3. Yield components. Vigour parameters. Uruñuela 2009.

NTU	Weight shoot (g)	Weight bunch (kg)	Weight of 100 berries (g)	Grape yield (kg/vine)	Weight of pruning wood (WPW) (kg wood/vine)	Ravaz index
1	73.1	0.367	235.6	4.1	0.79 **ab**	4.61
2	104.9	0.486	257.6	6.05	1.11 **a**	5.43
3	85.3	0.414	246.1	5.25	0.95 **ab**	5.65
5	81.8	0.374	235.3	4.91	0.78 **ab**	6.31
6	59.9	0.340	216.3	4.93	0.60 **b**	8.61

Different letters in same column indicate significant differences ($p<0.05$) in yield components data between NTUs, applying Tukey´s test

Tab. 4. Analytic composition of wines. Alcoholic degree and colour parameters. Uruñuela 2009.

NTU	Alcoholic degree	Colour intensity	Tonality	Total phenolic index (280 nm)	Anthocyanins (mg/l)
1	12.7	8.30 **ab**	0.600 **ab**	53.9	717.0
2	12.6	6.01 **b**	0.672 **a**	45.0	656.0
3	12.9	8.02 **ab**	0.567 **ab**	52.0	737.9
5	12.5	11.5 **a**	0.502 **b**	58.0	890.2
6	13.1	10.9 **a**	0.518 **b**	58.8	786.7

Different letters in same column indicate significant differences ($p<0.05$) in wine analysis data between NTUs, applying Tukey´s test.

Tab. 5. Analytic composition of wines. Acidity parameters.Uruñuela 2009.

NTU	pH	Titratable acidity (g/l tartaric acid)	Tartaric acid (g/l)	Potassium (mg/l)
1	3.72 **ab**	5.28	2.11 **ab**	1244.8 **ab**
2	3.90 **a**	4.71	1.74 **b**	1427.9 **a**
3	3.67 **ab**	5.55	2.31 **ab**	1216.8 **ab**
5	3.57 **b**	5.55	2.78 **a**	1098.2 **b**
6	3.68 **ab**	5.32	2.60 **ab**	1226.8 **ab**

Different letters in same column indicate significant differences ($p<0.05$) in wine analysis data between NTUs, applying Tukey´s test.

CONCLUSIONS

In Tempranillo (*Vitis vinifera* L.) vineyards of Uruñuela municipality (La Rioja region), we can define five Natural Terroir Units (NTUs), based on detailed cartography and in the pedologic, climatic, lithologic, and relief characteristics, with a different soil type in each NTU. This terroir survey, carried out during 2009 season, with three homogeneous and representative vineyard plots of each soil type, revealed some different between NTUs in the vine and wine parameters monitored. However, more experiments seasons are require to can discuss the terroir effect on vine development and wine typicity in this area.

ACKNOWLEDGMENTS

This survey is based on research (P.R.12.09) that was financially supported by Consejería de Agricultura, Ganadería y Desarrollo Rural, La Rioja Government.

We thank Bodegas Patrocinio, Uruñuela, for providing the experimental vineyards and collaborate in the study.

BIBLIOGRAPHY

Carey V., Saayman D., Archer E., Barbeau G. and Wallace M., 2008. Viticultural terroirs in Stellenbosch, South Africa. I. The identification of natural terroir units. *Journal International Science Vigne Vin*, n 4: 169-183.

García-Escudero E., Lorenzo I., Romero I., García C., Villar M.T., López D., Ibáñez S., Martín I., 2006. Niveles de referencia en base a calidad para el diagnóstico foliar en el ámbito de la D.O.Ca. Rioja. Nutrición mineral: aspectos fisiológicos, agronómicos y ambientales. *XI Simposio ibérico sobre nutrición mineral de las plantas,* n 2: 335-342.

Seguin G., 1988. Ecosystems of the great red wines produced in the maritime climate of Bordeaus. In: Proceedings of the Symposium on Maritime Climate Winegrowing. L. Fuller-Perrine, Eds. Edition. Department of Horticultural Sciences, Cornell University, Geneva, N.Y., n: 36-53.

Soil Survey Staff Natural Resources Conservation Service, U.S. Department of Agriculture, 2006. Keys to Soil Taxonomy. Tenth Edition. Blacksburg, Virginia: Pocahontas Press, Inc.

Van Leeuwen C., Friant P., Choné X., Tregoat O., Koundouras S., Dubourdieu D., 2004. Influence of climate, soil, and cultivar on terroir. *American Journal of Enology and Viticulture*, n 55.3: 207-217.

Van Leeuwen C., Seguin G., 2006. The concept of terroir in viticulture. *Journal Wine Research*, n 17.1: 1-10.