Soils, climate, nutritive status and production of cv «Palomino fino» in the superior quality area of the Jerez-Xérès-Sherry zone

Sols, climat, état nutritif et production de la vigne « Palomino fino » dans la région de qualité supérieure de la zone Jerez-Xérès-Sherry

Cristina PARDO[1], Patricia PANEQUE[1(*)], Celia ESPINO[1], Manuel CANTOS[2], Juana LIÑÁN[2] and Antonio TRONCOSO[2]

1: Departamento de Cristalografía, Mineralogía y Química Agrícola, Universidad de Sevilla, c/ Profesor García González 1, 41012 Seville, Spain
2: IRNAS-CSIC, P.O. Box 1052, 41080 Seville, Spain
*Corresponding author: pipaneque@us.es, Tel. +34 5 455 71 37, Fax +34 5 455 71 41

Abstract: The Registered Appellation of Origin Mark (RAOM) « Jerez-Xérès-Sherry and Manzanilla Sanlucar de Barrameda » is one of the oldest and more important zone in wine history and production. «Albarizas» unit (white calcareous marls with sea-fossils) is the most representative geological material of the RAOM (75%) and even more in the central-NW area of the RAOM, known as «Jerez Superior» area (Superior Quality Sherry Area). « Albarizas » form undulated hillocks (3-10% slope) and hills (>10% slope), the litologic unit has E-W and S-W direction, and Regosols and Leptosols are the principal soils. Chemical and physical analytical data show the high aptitude for vine culture of these soils. The Superior Quality zone has mean minimum temperatures between 10.3 and 12.5 °C, mean maximum between 22 and 24 °C, and the annual rainfall ranged between 513 to 624 mm. Climatic indexes indicated very good conditions for vine cultivation and high quality wine production. «Palomino Fino» is the main vine cv. both in the RAOM and Superior Quality Sherry area. There were no big differences in the nutritional status of the plants from the plots compared but a decrease of N, P, K and increase of Ca and Mg levels occurred along the reproductive cycle in all parts and classes of leaves. This behaviour was accelerated by leaf age and plant production.

Key words: Sherry, zoning, « albarizas », soils, nutrition

Introduction

The « Jerez-Xérès-Sherry and Manzanilla Sanlucar de Barrameda » RAOM has a surface close to 10,350 ha, sited in the SW of Andalusia, in the dip between the Guadalquivir and Guadalete rivers and Atlantic Ocean. Despite being one of the oldest and more important RAOM of the world in wine history and although interesting previous work exist (García de Luján, 1997; Hidalgo, 2003; Paneque *et al*., 2002; Osta *et al*., 2005), there is a lack of criterion and methods for vine-growing zoning.
« Jerez Superior » (Superior Sherry) area, close to Jerez de la Frontera town, is a subzone of the RAOM with a very high quality sherry wine production. Then, the goal of this work is to define the geopedological and climatic characteristics of this subzone in relation to those of the RAOM, and their influence on the nutritive status of the « Palomino Fino » vine cv.

Material and Methods

For pH, equivalent calcium carbonate (E-$CaCO_3$) available P, K, Ca, Mg and Na, cation exchange capacity, exchangeable cations (K^+, Ca^{++}, Mg^{++} and Na^+), total exchangeable bases (S) and percent base saturation (V), the MAPA official methods (1994) were used. Active limestone (AL) by Porta *et al.* (2003), chlorosis strength index (ChSI) by Morlat and Corube (1981), organic-C and total organic matter (OM) by Sims and Haby (1971) and Guitian and Carballas (1976), total-N by Kjeldahl (Duchaufour, 1975) and available Fe, Mn, Zn and Cu by Pinta (1971) methods were determined. Bulk density (ρ^b), particle density (ρ_s), total porosity (ξ_t), soil humidity (H_w, H_θ) and hydraulic conductivity of saturated soils (K_s) determinations were made by MAPA, (1994). The maximum soil aeration capacity (MAC) and soil aeration capacity (AC), field

capacity (FC), permanent wilting point (PWP), available water (AW) and available water retention capacity (AWRC) were determined by Guitian and Carballas (1976), MAPA (1994) and Porta et al., (2003) methods. For particle soil analysis Bouyoucos method (in MAPA, 1994) was used and textural class was defined by texture-triangle USDA (FAO, 1977). Soil structure was determined by FAO (1977) method and soil colour by Munsell soil colour charts (1994). Some bioclimatic index (table 3) were defined according to García de Luján (1997); Hidalgo (2003) and Tonietto *et al.* (2004). In the «Jerez Superior» area, 194 experimental plots with around 100 « Palomino Fino » vines each were selected. Through 6 years, leaf samples were taken every year in each of the following phenological phases of the plant reproductive cycle: (1) Inflorescence initiation (Apr); (2) Floral buds separation (May); (3) Anthesis (May); (4) Fruitset (Jun); (5) Veraison (Jun-Jul); (6) Maturation (Aug) and (7) Harvesting (Aug-Sep) in the leaf samples, N (Kjeldahl) and P, K, Ca and Mg by ICP-OES (Wallinga *et al.*, 1995) were determined.

Results and discussion

The prevailing geological materials found at the RAOM are those characteristic of the « Subbética » zone, as « Albarizas » unit (white calcareous marls with sea fossils), Trias-gypsum marls unit, and Quaternary zone (superior Miocen, Pleistocen and Quaternary units). « Albarizas » unit is the most representative in the RAOM (75%) and even more (84%) in the central-NW area of the RAOM known as « Jerez Superior » (Superior Sherry). It forms also a geomorphological unit with undulated hillocks (3-10% slope) and hills over 10% slope. These different heights, slopes and orientations determine different terroirs (« pagos »). The respective lythologic unit has E-W and S-W direction and the superficial drainage takes place by numerous streams going N (Guadalquivir river), S-W (Guadalete river) or W (directly to the Atlantic Ocean). The main soils developed on « Albarizas » are Regosols and Leptosols and can also be considered Calcisols, Cambisols and Vertisols. As the most representative soils in the « Jerez Superior » area, the analytical data of Regosols and Leptosols chemical and physical fertility are shown respectively in tables 1 and 2. These results indicate good characteristics for vine cultivation.

Table 1 - Analytical data of the chemical fertility of Regosols and Leptosols soils on «Albarizas» in the «Jerez Superior» area.

Parameter	Horizon and Depth		
	Ap (0-60 cm)	C_1 (60-140 cm)	C_2 (> 140 cm)
pH/H_2O	8.34	8.33	8.34
pH/KCl	7.57	7.49	7.53
P (gKg^{-1})	0.0275	0.0050	0.0037
N (gKg^{-1})	0.56	0.21	0.12
Org-C (gKg^{-1})	6.90	2.16	1.14
OM (gKg^{-1})	11.89	3.72	1.96
C/N	12.51	10.05	8.38
E-$CaCO_3$ (gKg^{-1})	409.29	401.35	354.92
AL	208.64	211.82	165.99
ChSI (gKg^{-1})	89.39	74.49	25.69
Fe (gKg^{-1})	0.0080	0.0091	0.0116
Cu (gKg^{-1})	0.0068	0.0018	0.0017
Mn (gKg^{-1})	0.0113	0.0092	0.0098
Zn (gKg^{-1})	0.0033	0.0023	0.0021
Ca^{++} ($cmol_cKg^{-1}$)	16.87	16.94	15.24
Mg^{++} ($cmol_cKg^{-1}$)	2.00	2.71	3.98
Na^{+} ($cmol_cKg^{-1}$)	0.68	0.70	1.45
K^{+} ($cmol_cKg^{-1}$)	1.34	0.48	1.06
EC ($cmol_cKg^{-1}$)	20.89	20.83	21.73
CEC ($cmol_cKg^{-1}$)	21.01	19.89	21.80
V (%)	100	100	100

Table 2 - Analytical data of the physical fertility of Regosols and Leptosols soils on « Albarizas » in the « Jerez Superior » area.

Parameter	Horizon and Deep		
	Ap (0-60 cm)	C_1 (60-140 cm)	C_2 (> 140 cm)
Sand (%)	16.61	13.24	12.67
Lime (%)	38.85	46.43	45.45
Clay (%)	44.54	40.33	41.79
H_w (%)	57.48	61.09	53.35
H_θ (%)	60.90	62.08	60.76
ρ^b (Kgm^{-3})	1069.99	1062.07	1165.14
ρ_s (Kgm^{-3})	2556.51	2560.27	2557.86
ξ_t (%)	58.11	58.55	54.46
K_s (cmh^{-1})	1.84	1.18	0.46
MAC (%)	69.19	69.24	66.00
AC (%)	26.07	22.40	13.90
FC (%)	43.12	46.84	52.10
PWP (%)	24.17	23.17	29.28
AW (%)	18.95	23.67	22.82
AWRC (m^3ha^{-1})	1137.0	1893.6	1369.2

Because of its geographical position, the influence of Atlantic Ocean and altitude, the « Jerez Superior » area is characterised by mean minimum temperatures between 10.3 and 12.5 ^oC, mean maximum between 22 and 24 ^oC and annual average close to 17.5 ^oC. The mean annual rainfall is around 614 mm, ranging from 513 to 624 mm and distributed from October to May with a dry summer period.

In table 3, some climatic indexes of the « Jerez-Xérès-Sherry and Manzanilla Sanlúcar de Barrameda » RAOM and «Jerez Superior» area are shown. These results indicated very good conditions for vine cultivation and high quality wine production.

« Palomino Fino » is the main vine cv. in the RAOM and in the « Jeréz Superior » area as well. According to the « Albarizas » unit and cultivation methods, there were no big differences in the leaf nutritive status among the 104 plots analysed at each phenological phase. On the contrary, differences were found when the nutritive status of the plants of each plot was compared through the phenological phases of the reproductive cycle. A continuous decrease of N, P and K and increasing of Ca and Mg were observed (table 4). This behaviour was similar in all the leaf parts (limb and petiole) and in all the leaves of the shoot although delayed according to leaf less age. This occurred both in the plants with high (>5.6 Kg/plant) and low (<3.4 Kg/plant) production, but more accentuated with high crop.

Table 3 - Climatic indexes (average of the « Jerez-Xérès-Sherry and Manzanilla Sanlúcar de Barrameda » (RAOM) and « Jerez Superior » area (JSA).

Index	ATI	ETI	HP	HI	cbI	CBI	GI	MCI		
Area								SI	FI	HI
RAOM	6.431	2.785	1.832	2.669	9.2	14.5	22	Si+1	FI–2	HI+2
JSA	6.178 to 6.519	2.528 to 2.869	1.300 to 1.918	7.6 to 8.6	8.3 to 9.7	12.6 to 15.2	16 to 26	Mod. Dry	Warm Night	Warm Clim.

Table 4 - Leaf nutrient contents (average of 104 plots and 6 years) of « Palomino Fino » vines in the « Jerez Superior » area of the RAOM « Jerez-Xérès-Sherry and Manzanilla Sanlúcar de Barrameda ».

Nutrient	Phenological phase						
% d.m.	1	2	3	4	5	6	7
N	3.40	3.25	2.90	2.37	1.90	1.78	1.48
P	0.51	0.39	0.32	0.27	0.18	0.15	0.11
K	1.35	1.26	1.10	0.86	0.71	0.55	0.45
Ca	1.46	1.89	2.80	2.90	3.40	3.70	3.90
Mg	0.20	0.20	0.23	0.27	0.29	0.29	0.33

(1) Inflorescence initiation; (2) Floral buds separation; (3) Anthesis; (4) Fruitset; (5) Veraison; (6) Maturation; (7) Harvesting.

References

DUCHAUFOUR Ph, 1975. *Manual de Edafología*. Toray-Mahon. S.A. España.

FAO, 1977. *Guía para la descripción de perfiles*. Roma.

GARCÍA DE LUJÁN A., 1997. *La viticultura del jerez*. Ed. Mundi-Prensa. Madrid. 163 pp.

GUITIÁN F., CARBALLAS T., 1976. *Técnicas de análisis de suelos*. Ed. Picro Sacro. Santiago de Compostela.

HIDALGO L. 2002. *Tratado de Viticultura General*. Mundiprensa.

MAPA, 1994. *Métodos Oficiales de Análisis. Tomo III: Suelos y Aguas*. Ministerio de Agricultura, Pesca y Alimentación. Servicio de Publicaciones Agrarias. Madrid.

MORLAT R et CORUBE, 1981. Caractérisation de quelques composantes du potentiel chlorosant des différents milieux carbonatés dans le vignoble du Val de Loire. *Connaissance Vigne Vin*, **4**, 229-245.

OSTA C.P., PANEQUE P., PÉREZ-CAMACHO F., TRONCOSO A., PANEQUE G., 2005. Pedological and climate zoning of the Pedro Ximenez vineyard of the Montilla-Moriles Registered Appellation of Origin Mark (RAOM) (Cordoba, Spain). Relationship with the plant nutritive status and fruit and must production and quality. *Proceedings Vol 2. GESCO 2005*. Geisenheim. Alemania.

PANEQUE P., GONZÁLEZ J.L., PANEQUE G., 2002. Pedological factor influence on the viticultural zoning of the Aljarafe Alto (Seville, Spain). *Symp. Int. Zonage Vitivinicole*. Avignon, France.

PINTA M., 1973. Méthodes de référence pour la détermination des éléments minéraux dans les végétaux. Détermination des éléments Ca, Mg, Fe, Mn, Zn et Cu par absorption atomique. *Oléagineux*, **28**, 87-92.

PORTA CASANELLAS J., LOPEZ-ACEVEDO M., ROQUERO C., 2003. *Edafología para la Agricultura y el Medio Ambiente*. Ediciones Mundi-Prensa. Madrid.

SIMS J.R., HABY V.A., 1971. Simplied colorimetric determination of soil organic matter». *Soil Sci*., **112**, 137-141.

TONIETTO, J., CARBONNEAU A, 2004. A multicriteria climatic classification system for grape-growing regions worldwide. *Agricultural and forest meteorology*. Elsevier.

WALLINGA I., VAN DER LEE J.J., HOUBA V.J.G., VAN VARK W., and NOVOZAMSKY I., 1995. *Plant Analysis Manual*. Kluwer. Dordrech. Netherlands.