ASSESSMENT OF TEMPRANILLO GRAPES QUALITY IN THE VINEYARD BY VITUR SCORE-SHEET

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Abstract

Aims: The main objective of this study is to determine whether the Vitur score-sheet could be applied as a reliable method for assessing winegrape quality in the vineyard.

Methods and results: Grape assessment of vineyards (*Vitis vinifera* L. 'Tempranillo') in the Rioja Appellation was performed by Vitur score-sheet, proposed by Tardáguila and Martínez de Toda (2005). Vegetative growth, yield components and the chemical composition of the grapes were also determined. Correlation analysis between vineyard variables and the chemical composition of the grapes were performed to identify characteristics associated with grape quality. The Vitur value was the studied parameter that displayed the best correlation with the chemical composition of the grapes. Vitur value was significantly correlated with extractable and total anthocyanins, total polyphenols index, sugar content, titratable acidity, tartaric acid and malic acid content.

Conclusions: This article reports a new approach to winegrape assessment in the vineyard. The Vitur methodology was a fast and reliable method for assessing Tempranillo grape quality in the vineyard under Spanish conditions.

Significance and impact of study: The results suggest that wine industry could use a Vitur methodology, as tool to classify grapes in a simple and rational manner before the harvest and winemaking

Key words. Vineyard assessment, Vitur score-sheet, canopy surface area/yield ratio, Tempranillo, *Vitis vinifera*

Résumé

Objectif : Le principal objectif de ce travail est d'établir si la feuille de points Vitur peut être utilisée comme une méthode fiable pour évaluer la qualité des baies de raisin au vignoble.

Méthodes et résultats : L'évaluation des vignobles (*Vitis vinifera* L. cv Tempranillo) dans l'Appellation Contrôlée Rioja, a été effectuée avec la feuille de points Vitur, proposée par Tardáguila et Martínez de Toda (2005). En outre, on a aussi déterminé la vigueur végétative, les composantes de rendement ainsi que la composition chimique des baies. Afin d'identifier quelles sont les caractéristiques les plus pertinentes de la qualité de la baie de raisin, des analyses de corrélation entre les indicateurs du vignoble et la composition de la baie de raisin ont été conduites. Le meilleur coefficient de corrélation entre ces paramètres a été observée par la valeur Vitur. Cet indicateur va être corrélé significativement avec la totalité des anthocyanes ainsi que les anthocyanes qui peuvent être extraits, la quantité totale des polyphénols, la teneur en sucre, l'acidité totale, et les concentrations d'acide tartrique et d'acide malique.

Conclusion : Ce travail présente une nouvelle approche pour évaluer la qualité de la baie de raisin au vignoble. La méthodologie Vitur est une procédure rapide et fiable pour évaluer la qualité de la baie de raisin de cépage Tempranillo au vignoble cultivé selon les règlements en Espagne.

Signification et impact de l'étude : Les résultats suggèrent l'utilisation de la méthodologie Vitur pour le secteur du vin, pour classifier les baies de raisin d'une manière facile et rationnelle avant la vendange.

Mots-clés : évaluation de la vigne, feuille de points Vitur, rapport surface foliaire exposée/kg de raisin, Tempranillo, *Vitis vinifera*

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INTRODUCTION

Wines, and the grapes they are made from, are differentiated products. Until several years ago grape prices were poorly related to their real value. Nowadays, the wine-growing industry acknowledges the relationship between grape pricing, grape quality and wine quality.

A reliable method for assessing winegrape quality in vineyards would enable to classify the grapes and produce separate wines depending on their quality. A rigorous and objective method would promote the concept of « grape and wine quality » among growers and wineries. It would also help to ensure an open and objective system for determining the final price of grapes, thus improving seller/buyers relations. Special emphasis should be placed on bringing more clarity and transparency to winegrape specification and winegrape quality attribution in grape transactions,

So the problem is how to quantify the quality, and hence value, of winegrapes before vinification. Many wineries use sugar content only or several parameters, such as pH and titratable acidity, to assess grape quality. This system is too simple and does not allow establishing a clear and rigorous connection with final wine quality. Therefore, grape quality must be assessed by a rapid and reliable method. In recent years, several systems for quickly determining many physico-chemical parameters in musts and wines have been developed (Dubernet and Dubernet, 1999), although their widespread application remains complex. Recently, berry sensory assessment proved to be an interesting method for assessing winegrapes prior to vinification (Winter *et al.*, 2004).

As regards winegrape assessment in vineyards, Smart proposed and developed the first score-sheet (Smart and Robinson, 1991). Later, in Australia, Gray *et al.* (1994 and 1997) tried to identify characteristics associated with winegrape value and, ultimately, wine quality. In these reports, over one thousand individual vineyards were scored in different Australian wine regions but the wine value index did not relate consistently to any single characteristic. On this topic, Krstic *et al.* (2003) have published an interesting book on growing quality grapes to winery specifications. The Winegrape Growers' Council of Australia and the Winemakers' Federation of Australia are working on best practices in winegrape assessment (Allan, 2003). In some European countries, different researchers have contributed to the development of a number of methods for evaluating grape quality in vineyards, namely in France (Carbonneau, 1995) and Italy (Bertamini *et al.*, 1994). Most of these studies focus on problems relating to vineyards located in fertile areas or/and with abundant water supply. In dry areas, it would also be useful to have methods for assessing grape quality in vineyards and identifying potential problems that may arise during the vegetative and fruit development of the vines.

This report is an extension of the study begun in the region of Rioja appellation (northern Spain) in 2002 by the University of La Rioja supervising a research project with the participating commercial winery. The general approach and preliminary results of grape assessments in vineyards in Mediterranean viticulture were reported by Tardaguila and Martinez de Toda (2004 and 2005). The main objective of this study is to determine whether the Vitur score-sheet, developed by the University of La Rioja, could be applied as a reliable method for assessing winegrape quality in the vineyard.

MATERIALS AND METHODS

The study was performed in 25 commercial vineyards and concerns *Vitis vinifera* L. « Tempranillo » in the wine producing region of DOC Rioja (Spain). Tempranillo vines were 2 buds spur pruned in a double cordon, and trained to a vertically shoot-positioned (VSP) trellis system. 12 buds per vine were left after pruning. The trellis consisted of a double cordon at 65 cm, 2 wires at 95 cm for protection against wind damage and a pair of movable shoot positioned wires at 130 cm. Vine density varied between 2,800 and 3,500 vines/ha. The vines were grafted on different rootstocks and planted in different years. Vines were not irrigated during growing season and shoots were trimmed in August. Normal cultural practices were applied.

1. Vineyard assessment

The assessment of grape quality in the vineyards was performed before harvest. The techniques applied to diagnose the state of the vineyards were:

a- Assessment of growth, leaf area and crop yield

In each vineyard, a number of ten vines were chosen and tagged just before harvest, so that each vine was located in a different row, following a randomized design by row and vine (Smart and Robinson, 1991). For each vine, the following parameters were determined before harvest using the method proposed by Smart and Robinson (1991): shoots per vine, nodes per shoot, clusters per shoot, clusters per vine, crop weight, total leaf area and exposed canopy surface area. During winter, the pruning weight per vine was also determined for the same tagged 10 vines. Cane weight and yield/pruning weight ratio were calculated.

b- Assessment by Vitur score-sheet

In all vineyards, grape assessment was performed by Vitur score-sheet (figure 1) proposed by Tardaguila and Martinez de Toda (2005), before harvest. Eleven variables

were used per Vitur score-sheet: exposed canopy surface area/yield, leaf layer number, leaf condition, water stress symptoms, growing tips presence, vigour, fruit health status, fruit exposure, cluster size, fruit colour and berry size. Leaf condition was related to leaf health and nutritional status. Vigour was associated to shoot length and lateral growth. Water stress symptoms were related to the percentage of growing tips on all main shoots and laterals that have stopped. All the variables used in Vitur score-sheet had 3 score levels and a weighting factor varying between 2 and 5. Total Vitur score-sheet points were referred to as the Vitur value.

2. Grape analysis

A sample of 20 clusters for the same tagged 10 vines (2 randomized clusters per vine) of each vineyard was taken at harvest. Phenolic maturity was determined in the laboratory using the method proposed by Saint-Cricq de Gaulejac *et al.* (1998). The following parameters were determined: total polyphenols index, colour intensity, total anthocyanins and extractable anthocyanins.

Other sampled clusters were used to determine the physico-chemical composition of the grapes. One hundred berries were selected and manually squeezed. The must obtained, once filtered, was analysed using a multiple-parameter analyser WineScan FT 120 (FOSS, Denmark) and Grapescan as software. The determined parameters were: sugar content (Baumé degree), titratable acidity, pH, tartaric and malic acid.

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VITUR score-sheet
for vineyard assessment

GENERAL DATA

Date:		Wine region:
Technician:		Vineyard Code:
Grower:		Vineyard surface:
Rootstock:		Variety and clone:
Type of soil:		Training system:
Row spacing:	Vine spacing:	Vine density (vines/ha):

CANOPY DATA

Sv: Shoots per vine:	**Cv:** Clusters per vine:
Cw: Cluster weight:	**Y:** Crop yield (kg/vine):
Hc: Exposed canopy height:	**Wc:** Exposed canopy width:
Wi: "windows" in the canopy (%):	**CSA:** Exposed canopy surface area (m^2/ha):

Criteria	Points			Weighting Factor	Points
	1	2	3		
CSA/Y (m^2/Kg)	< 0.8	0.8 – 1.2	> 1.2	5	
Leaf layer number	> 4	< 3	3 – 4	2	
Leaf condition (% unhealthy leaves)	> 10%	2% - 10%	< 2%	2	
Water stress symptoms	High or very low	Moderate	Light stress	2	
Growing tips presence	High	Moderate	None	2	
Vigour	High	Low	Moderate	2	
Fruit health status (% clusters with diseases)	> 5%	1% - 5%	< 1%	4	
Fruit exposure (%)	< 20%	> 70%	20 – 70%	3	
Cluster size	Big	Moderate	Low	2	
Fruit colour	Heterogeneous	Light Heterogeneous	Homogeneous	3	
Berry size	Big	Moderate	Low	3	
VITUR Value (Total points)					

Figure 1 - Vitur score-sheet used for winegrape assessment in the vineyard (Tardaguila and Martinez de Toda, 2005).

RESULTS AND DISCUSSION

Table 1 shows the results of the linear correlation analysis between all quantitative parameters determined in the vineyards and the chemical composition of the grapes, responsible for both pulp ripening and the phenolic maturation of the grapes. These results indicated that there were different groups of vineyard variables. The first group comprised vineyard parameters without or with low relationships with grape juice composition. Vineyard age, pruning weight, yield/pruning weight ratio, total and exposed leaf area, total leaf area/canopy surface area ratio and leaf condition were not good indicators of Tempranillo grape composition. Other vineyard variables with strong relationships with fruit composition were in the second

Table 1 - Correlation (Pearson's correlation coefficient and significance) between all quantitative vineyard variables (vineyard age, clusters per shoot, yield per vine, shoot length, pruning weight, cane weight, yield/pruning weight, canopy surface area (CSA), total leaf area (TLA), TLA/yield, TLA/CSA, CSA/yield, leaf condition, fruit health status, fruit exposure and Vitur value) and grape quality parameters.

	Extractable anthocyanins	Total anthocyanins	Total polyphenols index	Colour intensity	Sugar content	Titratable acidity	pH	Tartaric acid	Malic acid
Vineyard age	0.17 NS	0.18 NS	0.21 NS	0.12 NS	-0.20 NS	-0.31 NS	0.05 NS	0.03 NS	-0.15 NS
Clusters per shoot	-0.60 ***	-0.69 ***	-0.35 NS	-0.73 ***	-0.34 NS	0.27 NS	-0.29 NS	-0.55 **	0.19 NS
Yield per vine	-0.57 **	-0.58 **	-0.58 **	-0.67 ***	-0.18 NS	0.51 **	-0.2 NS	-0.41 *	0.32 NS
Shoot length	-0.36 NS	-0.32 NS	-0.32 NS	-0.28 NS	0.10 NS	0.43 *	-0.06 NS	-0.27 NS	0.39 *
Pruning weight	-0.39 NS	-0.37 NS	-0.14 NS	-0.28 NS	-0.06 NS	0.47 *	-0.05 NS	-0.28 NS	0.37 NS
Cane weight	-0.35 NS	-0.33 NS	-0.02 NS	-0.18 NS	0.02 NS	0.39 NS	-0.01 NS	-0.13 NS	0.27 NS
Yield / Pruning weight	-0.24 NS	-0.27 NS	-0.33 NS	-0.43 *	-0.04 NS	0.14 NS	-0.20 NS	-0.22 NS	0.07 NS
Canopy surface area	0.06 NS	0.10 NS	-0.09 NS	0.05 NS	0.58 **	0.15 NS	-0.05 NS	0.15 NS	0.04 NS
Total leaf area	-0.35 NS	-0.25 NS	-0.49 *	-0.29 NS	0.12 NS	0.40 *	-0.20 NS	-0.19 NS	0.24 NS
TLA/Yield	0.21 NS	0.38 NS	-0.03 NS	0.38 NS	0.47 *	0.03 NS	-0.02 NS	0.30 NS	-0.08 NS
TLA/CSA	-0.27 NS	-0.26 NS	-0.30 NS	-0.23 NS	-0.51 **	0.25 NS	-0.10 NS	-0.29 NS	0.21 NS
CSA/Yield	0.49 *	0.59 **	0.31 NS	0.58 **	0.58 **	-0.14 NS	0.14 NS	0.43 *	-0.13 NS
Leaf condition	-0.16 NS	-0.08 NS	0.10 NS	-0.04 NS	-0.43 *	-0.23 NS	-0.22 NS	0.10 NS	-0.32 NS
Fruit health status	-0.42 *	-0.47 *	-0.33 NS	-0.28 NS	-0.07 NS	0.58 **	-0.32 NS	-0.42 *	0.43 *
Fruit exposure	0.34 NS	0.32 NS	0.31 NS	0.30 NS	-0.45 *	-0.44 *	0.28 NS	0.26 NS	-0.26 NS
Vitur value	0.77 ***	0.81 ***	0.43 *	0.67 ***	0.38 *	-0.62 ***	0.31 NS	0.59 **	-0.48 **

NS, *. ** and *** represent not significant and significant differences at the 0.05, 0.01 and 0.001 levels, respectively.

group. Thus, yield per vine, exposed surface area/yield ratio and fruit health status displayed a strong relationship with colour and juice composition. In other words, each vine parameter was significantly correlated with five fruit characteristics. As an example, figure 2 shows the negative linear correlation between the total polyphenols index and yield per vine (R^2=0.337**). Figure 3 shows the graphic representation of the parabolic relationship between total anthocyanins and the canopy surface area/grape yield ratio (R^2=0.449**). Basically, these results proved that the exposed surface area/grape yield ratio was a good indicator of the phenolic composition of the grapes, something that is very difficult to determine or estimate by simple and rapid physico-chemical methods. This

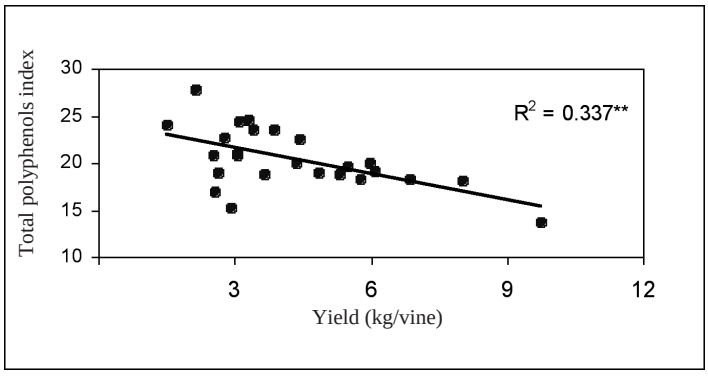

Figure 2 - Significant correlation between total polyphenols index and yield per vine (p<0.01). The correlation coefficient R^2 and the fitted straight line are shown.

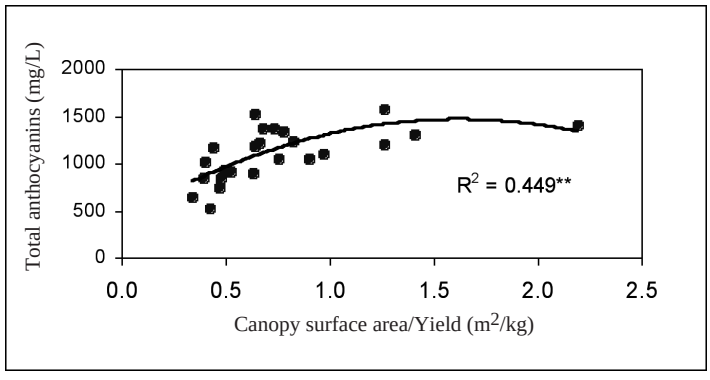

Figure 3 - Relationship between total anthocyanins and canopy surface area/yield ratio. The R^2 value, significance (p<0.01) and the fitted parabolic curve (quadratic model) are shown.

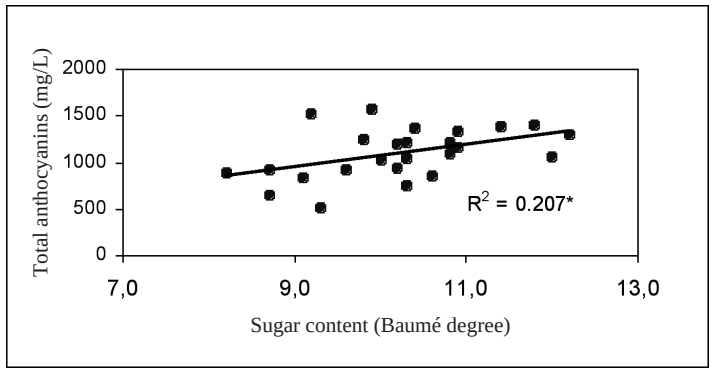

Figure 4 - Significant correlation between total anthocyanins and sugar content (p<0.05). The correlation coefficient R^2 and the fitted straight line are shown.

tendency in the results coincides with results reported in the bibliography on the positive impact of canopy surface area on grape ripening and, particularly, on their phenolic maturation (Kliewer and Weaver, 1971; Smart and Robinson, 1991; Bertamini et al., 1994; Tardaguila et al., 2004).

In many wineries, sugar content is used as an indicator of winegrape quality. We found that sugar content was significantly correlated with total anthocyanins and colour intensity only (Tardaguila and Martinez de Toda, unpublished data). Figure 4 shows the relation between total anthocyanins and sugar content (R2=0.207*). These results indicated that sugar content was only a rough guide for determining winegrape value.

Finally, the parameter that displayed the best correlation with the chemical composition of the grapes was the Vitur value. As shown in table 1, Vitur value was significantly correlated with all grape quality-related parameters (except pH). Figure 5 shows significant correlations between Vitur value and eight grape composition variables. Hence, the Vitur value was positively related with colour, total polyphenols index, sugar content and tartaric acid content, and negatively correlated with titratable acidity and malic acid content. Basically, these results revealed that Vitur value was the best indicator of phenolic composition and certain relevant parameters related to the chemical composition of the grapes.

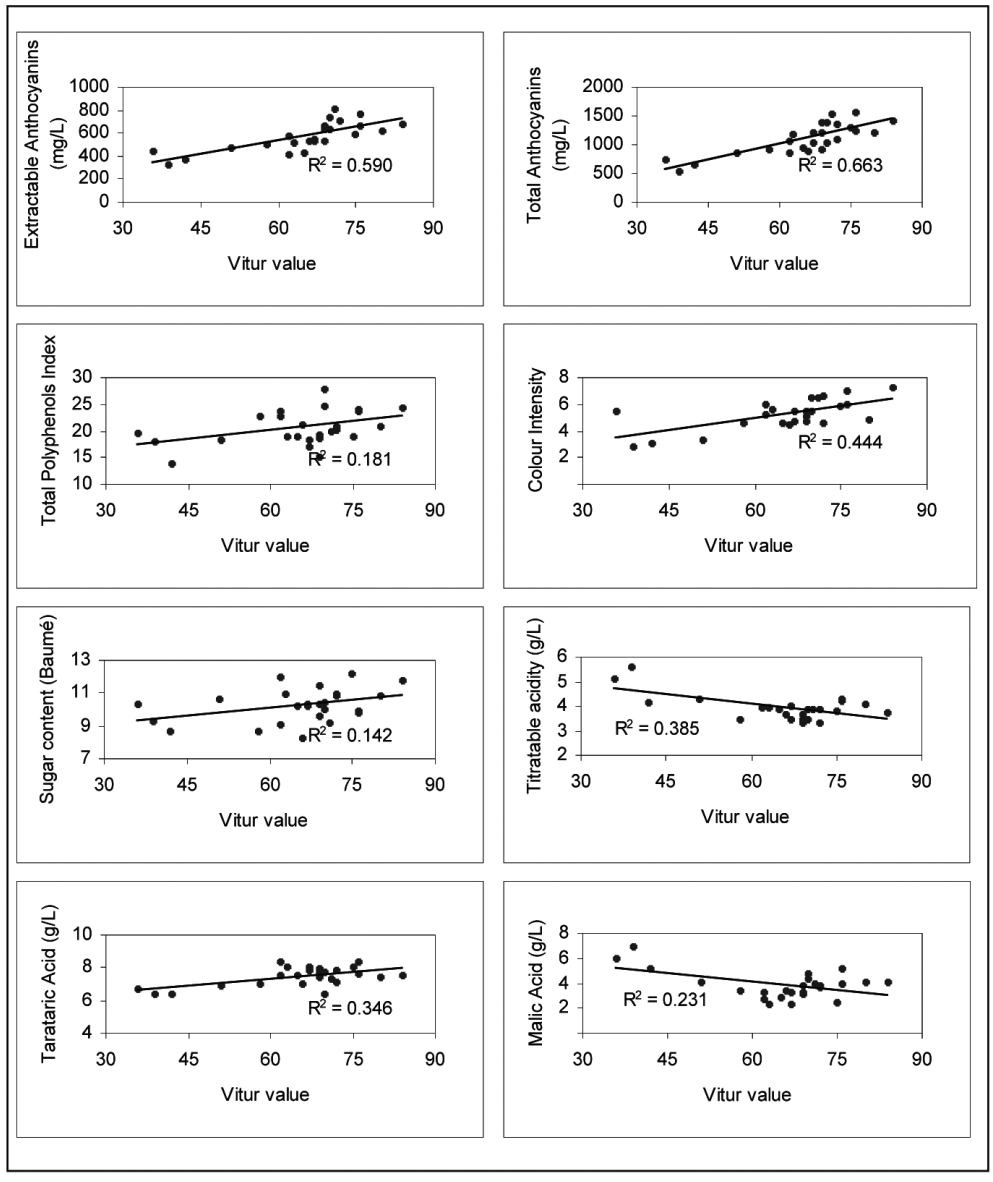

Figure 5 - Significant correlations among Vitur score-sheet value in different vineyards and fruit composition variables ($p<0.05$). The correlation coefficient R^2 and the fitted straight line are shown.

Note that the 25 vineyards studied were very different in terms of soil, water availability, vine age, rootstock, and cultivation techniques applied, and therefore the existence of a certain correlation between a Vitur score-sheet value and grape composition parameters is quite encouraging for this type of study aimed at estimating grape quality in the vineyard.

In conclusion, the Vitur methodology is a fast and reliable method for assessing Tempranillo grape quality in the vineyard under Spanish conditions. If the wine industry could use a method with these characteristics, grapes could be classified in a simple and rational manner before the harvest and winemaking.

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