CORRESPONDENCE BETWEEN PHYSIOLOGICAL PLANT VARIABLES AND CARBON ISOTOPE COMPOSITION IN DIFFERENT CLIMATE WINEGRAPE REGIONS

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Abstract:

Context and purpose of the study – The climate is the environmental factor that contributes with greater weight in the variability of the yield and the composition of the grape, therefore, it is key in the determination of the typicity of the product. Of the environmental factors, the evolution of water availability conditions, among other things, the biochemical evolution of the compounds of the grape and the type of wine to be elaborated. An integrating parameter of the hydric state of the plant is the carbon isotopic composition (δ13C). This indicator is a useful parameter to characterize the water status during the maturation period and estimate the transpiration efficiency or water use efficiency (EUA) in the vine. The aim of this study was to evaluate the ability of δ13C to differentiate wine growing regions of Uruguay by the relationship between the isotope indicator and the main productive variables.

Material and methods – The study was conducted in 2018 in commercial vineyards of the Tannat variety grafted on to SO4 rootstock, trained in a trellis system. The vines were planted in a four different climate regions for Uruguay determined by Multicriterial Classification system (MCC): 1-IH5, IF2, IS1-Salto (North, corresponds to a warm climate, cool nights and moderate drought), 2- IH_4, IF_2, IS_1-Durazno (Center, corresponds toa temperate-warm climate, nights and moderate drought), 3- IH4, IF1, IS1-Colonia (Northwest, corresponds to a temperate-warm climate, warm nights, moderate drought), and 4- IH3, IF2,IS1-Canelones (South corresponds to a temperate climate, cool nights and moderate drought). Climatic data were obtained from meteorological stations in each region according to World Meteorological Otganization (WMO standards). For each climatic region, the state hydric of the plant (ψb) was determined in four moments in the cycle; at harvest: berry weight, free amino nitrogen in must, δ13C in berries, pH, acidity, sugars and total and extractable anthocyanins it was determined.

Results – In the studied zones, under rainfed conditions, the values of δ13C were correlated to the water deficit. The δ13C was strongly correlated with the hydric state of the plant and allowed to differentiate the two most extreme climatic regions (1 and 4). The most negative δ13C values were obtained in climatic zone 1 (warm), explained by the rainfall accumulated during the maturation period. The δ13C showed significant correlations with the weight of the berry for each of the zones, free amino nitrogen in the berry, total and extractable anthocyanins, and the total acidity. These results indicate that δ13C, is an interesting indicator to evaluate the quality of the grape and confirm climatic regions.

Keywords: $\delta^{13}C$, Tannat, water status, climatic regions

1. Introduction.

CORRESPONDENCE BETWEEN PHYSIOLOGICAL VARIABLES OF THE PLANT AND STABLE ISOTOPE CARBON IN DIFFERENT CLIMATE WINEGRAPE REGIONS

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INTRODUCTION & OBJECTIVE

Of the environmental factors, the **evolution of water availability** conditions, among other things, defines the type of wine to be elaborated. **An integrating parameter** of the **hydric state** of the plant is the carbon isotopic composition (**$\delta^{13}C$**).

The **aim** of this study was to evaluate the **capability of $\delta^{13}C$ to differentiate wine growing regions of Uruguay** and the **relationship** between the **isotope** indicator and the main **productive variables.**

Figure 1: Multicriterial Classification System (MCC) and experimental plots in Uruguay. (Ferrer, 2007).
1- Salto; 2- Durazno; 3- Colonia; 4-Canelones.

MATERIALS & METHODS

4 experimental plots:
1- North: warm climate, cool nights and moderate drought.
2- Center: temperate-warm climate, nights and drought moderate.
3- Northwest: temperate-warm climate, warm nights, moderate drought.
4- South: temperate climate, cool nights and moderate drought.
During harvest 2018, the hydric state of the plant (ψb), exposed foliar surface, yield, berry weight, free amino nitrogen in must, $\delta^{13}C$ in berries, pH, acidity, sugars and total and extractable anthocyanins was **determined**.

RESULTS

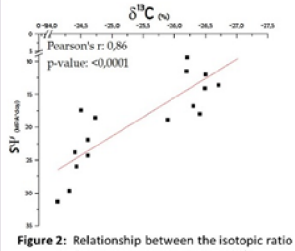

Figure 2: Relationship between the isotopic ratio ($\delta^{13}C$) and the stress integral (SΨ)

- **Good relationship,** between the water state and the δ13C value measured in 'Tannat' berries at harvest.
- The $\delta^{13}C$ is an **integrator of the hydric state** of the crop throughout the growing season.

- The **$\delta^{13}C$ was strongly correlated** with the hydric state of the plant and allowed to differentiate the two most extreme climatic regions (1 and 4).
- The most negative $\delta^{13}C$ values were obtained in climatic zone 1 (warm).

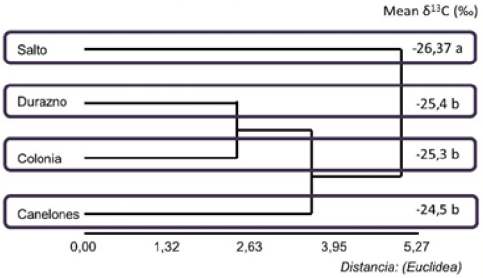

Figure 3: Cluster analysis of main productive variables. For each site mean of $\delta^{13}C$. Different letter denote significant differences between treatments at $p < 0,01$ by Fisher's test.

- The $\delta^{13}C$ showed **significant correlations** with the **berry weight** for each of the zones, **exposed foliar surface, pH, free amino nitrogen in the berry, total anthocyanins.**
- The isotopic ratio allows the **regions** to be **separated** according to the productive variables evaluated.

CONCLUSION

The $\delta^{13}C$ is an interesting indicator to:

- Integrators of plant water status
- Confirm climatic regions
- Evaluate the quality of the grape.

ACKNOWLEDGMENTS

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