

IMPACT OF SOIL CHARACTERISTICS ON GRAPE COMPOSITION OF TEMPRANILLO VARIETY UNDER DIFFERENT WEATHER CONDITIONS IN RIOJA DOCa (SPAIN)

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Abstract

Aims: Soil characteristics, as one of the elements of terroir, can have a significant effect on controlling vine development and grape composition. Soil particle distribution and porosity governs the volume of soil that can be explored by roots, and also soil water storage as well as water availability, and finally, the vine water status. The aim of the research was to analyse the relationship between grape composition of the cv. Tempranillo and soil water availability during the growing periods that have a higher influence on vine development.

Methods and Results: The study was conducted in vineyards from the Rioja DOCa (Qualified Designation of Origin), Spain. Six plots planted with cv. Tempranillo, located at similar elevation above the sea level. and in soils with different properties, were chosen for this research study. The plots were cultivated under rainfed conditions. Soil properties of each plot were taken from the European Soil Database (ESDAC). In addition, daily climatic data recorded in meteorological stations near the plots, which belonged to the Rioja Government, were used in the analysis. The available soil water (ASW) was estimated for the period 2008-2018, taking into consideration the soil properties and the weather conditions recorded at each location. Soil water content during the growing season was calibrated with the values recorded in an additional plot, located in the same area and at similar elevation. The influence of available soil water in different periods during on grape composition (berry weight, acidity and phenolic composition) at maturity was analysed. and the influence of available soil water.

The results confirmed the effect of soil properties on water availability for the vines and showed that under the rainfed conditions in which the vines were cultivated, vines suffered from moderate to high water stress in some periods along the growing cycle. Different critical periods regarding water availability for grape composition were identified between bloom and the end of ripening. The results also showed that an increase in the available soil water between one and three weeks after bloom and at the end of the ripening period increased grape acidity and decreased pH, while an increase in available soil water content between two and seven weeks after bloom and at the ripening period increased berry weight and decreased anthocyanins and other phenolic compounds.

Conclusion: From this research we can conclude that the level of water stress and the time when it appears under similar weather conditions depends on soils characteristics and has an influence on grape composition. The periods that have higher influence for Tempranillo variety were identified.

Significance and Impact of the Study: The results identified the influence of soil properties on available soil water and periods in which water deficits can have higher impact on the variety Tempranillo. Knowledge of the soil conditions that can offer more favorable soil water reserves and higher soil water availability may be of interest to mitigate the effects of warmer conditions recorded under climate change, resulting in higher evaporative demands.

Keywords: Acidity; anthocyanins; berry weight; polyphenols; soil characteristics; available water content

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The aim of this research was to analyse the relationship between grape composition of the Tempranillo variety, and available soil water along the growing cycle as well as the periods which have higher influence on vine development in Rioja DOCa.





Fig. 1 .Location of the study area within Rioja DOCa (Spain).

Table 1. Soil properties of the analysed plots (P1–P7). (Elev: altitude above sea level; OM: organic matter; FC: field capacity and WP: wilting point).

Plot	Elev	Clay	Silt	Sand	Coarse	ом	FC	WP
	a.s.l	(%)	(%)	(%)	elements	(%)	(%)	(%)
	(m)				(%)			
P1	438	22.8	34.6	42.6	13.2	1.1	26.6	12.8
P2	465	22.3	38.4	39.3	14.2	1.00	26.9	12.4
P3	450	25.5	45.3	29.2	13.0	0.75	30.1	13.7
P4	428	19.7	41.7	38.6	18.0	1.53	25.4	11.0
P5	440	22.2	43.2	33.9	17.8	1.40	27.6	15.3
P6	457	25.9	43.4	30.7	14.5	0.49	27.0	10.9
P7	450	18.5	43.2	38.3	12.0	0.96	27.0	15.5

Materials and Methods

The study was conducted in vineyards from the Rioja DOCa (Qualified Designation of Origin), Spain. Six plots planted with cv. Tempranillo, located at elevations between 428 and 465 m a.s.l. were considered in this research (Fig. 1). The soil characteristics of the plots are shown in Table 1. Daily weather conditions were recorded stations close to the plots which belong to the Rioja Government. The average values corresponding to the growing season during the study period are shown in Table 2. The available soil water (ASW) was simulated for the period 2008-2018, considering the soil properties and the weather conditions recorded at each location. Grape composition (berry weight, acidity and phenolic composition) was analysed between veraison and maturity and related to available soil water along the growing cycle.

Table 2. Average mean, maximum and minimum temperature (TmGS, TmaxGS, TminGS), precipitation (PGS) and crop evapotranspiration (ETcGS) recorded during the growing season (April-October) and precipitation recorded in the hydrological year (1stOct-30thSept) (PHY) in the period (2008-2018).

Weather station	TmGS	TmaxGS	TminGS	РНҮ	PGS	ETcGS	
	(°C)	(°C)	(°C)	(mm)	(mm)	(mm)	
Logroño	17.6±0.8	24.1±1.0	12.1±0.5	472±122	241±109	495 ±42	
Uruñuela	16.9±0.8	24.4±1.1	10.6±0.6	477±108	246±91	403±100	
Haro	17.4±0.7	24.4±1.0	12.1±0.5	464±113	190±93	426± 26	
Nájera	17.5±0.9	24.5±1.2	11.6±0.5	369±105	179±58	437±26	
San Vicente de	16.9±0.6	23.8±0.9	10.9±0.5	573±121	257±84	488± 43	
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Results and Conclusions

High variability were observed within the analysed period, in the weather conditions, with high temperatures (2017), very wet (2008, 2013 and 2018) and very dry (2009, 2011) years, and years with irregular rainfall distribution (2016). Year 2014 had intermediate conditions. It conditioned the available water during the growing season, which was also influenced by soil properties (Fig.2). The PLS regression analysis performed for the ensemble of analysed plots and years, between the grape parameters and ASW along the growing cycle, allowed confirming the time for which water availability plays an important role for grape quality (Fig.3).



stage -H Ver-M - 2009 - 2011 - 2013 - 2014 - 2016 - 2018 - 2017

Fig, 2. ASW along the growing cycle in the plots P1-P6 in years with different weather conditions (2009, 2011 and 2016: dry years; 2013 and 2018: wet years; 2017: very high temperatures; and 2014: intermediate characteristics).



Fig. 3. Coefficients of the PLS regression analysis performed for the ensemble of analysed plots and years between the grape parameters and ASW from stage H until reaching ripening (13°), analysed weekly (week 1 to 18; W1-W18): a) acidity; b) polyphenols, c) berry weight.

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