EVALUATION OF CLIMATE CHANGE IMPACTS AT THE PORTUGUESE DÃO TERROIR OVER THE LAST DECADES: OBSERVED EFFECTS ON BIOCLIMATIC INDICES AND GRAPEVINE PHENOLOGY

Vanda Pedroso[1], Pedro Rodrigues[2] and Carlos M. Lopes[3]

[1]DRAPC/Centro de Estudos Vitivinícolas do Dão, Nelas, Portugal.
[2]CERNAS-IPV Research Centre, Polytechnic Institute of Viseu, Campus Politécnico, Repeses, 3504-510 Viseu, Portugal.
[3]LEAF, Instituto Superior de Agronomia, Universidade de Lisboa, Portugal.

BACKGROUND and AIMS

In the last decades the growers of the Portuguese Dão winegrowing region (center of Portugal) are experiencing changes in climate that are influencing either grape phenology berry health and ripening. Aiming to study the relationships between climate indices, seasonal weather and grapevine phenology, in this work long-term climate and phenological data collected at the experimental vineyard of the Portuguese Dão research centre between 1958 and 2019 (61 years) for the red variety Touriga Nacional, was analyzed.

MATERIAL and METHODS

- **Site**: Nelas, Portugal, lat. 40°31'N, long. 7°51'W, elevation 440 m), 1958-2019;
- **Soil**: granitic origin, with a coarse texture and acid pH, with very good infiltration capacity, low organic matter content, medium content of phosphorus and high potassium content;
- **Variety/rootstock**: Touriga Nacional/ 420 A, 161-49, 3309 Couderc, 110 Richter, 99 Richter and 161-49;
- **Vine spacing**: 1.80 x 1.1 m (1963-1987); 1.80 x 1.0 m (1995-2019);
- **Training system**: VSP; spur pruning;
- **Experimental design:** Rondomized complete block design with 28 vines per block.

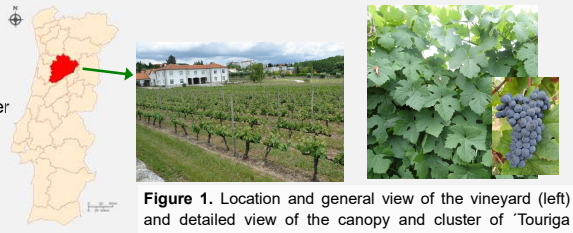

Figure 1. Location and general view of the vineyard (left) and detailed view of the canopy and cluster of ´Touriga Nacional´ (right).

Assessments: Meteorological data (weather station within the experimental vineyard) and berry composition at harvest;
Data Analysis: For each season the following classical bioclimatic indices were calculated: growing season temperature (Jones et al., 2010), Huglin index (Huglin, 1986), cold night index (Tonietto and Carbonneau, 2004) and dryness index (Riou et al., 1994).
A database with bioclimatic indices, phenological and berry composition data (total soluble solid) was built using available data. Furthermore accumulated rainfall and average maximum and minimum temperature were determined for the ripening period at each season (fixed in 45 days before harvest). Correlations and regression analysis between bioclimatic indices and harvest date were performed.

RESULTS

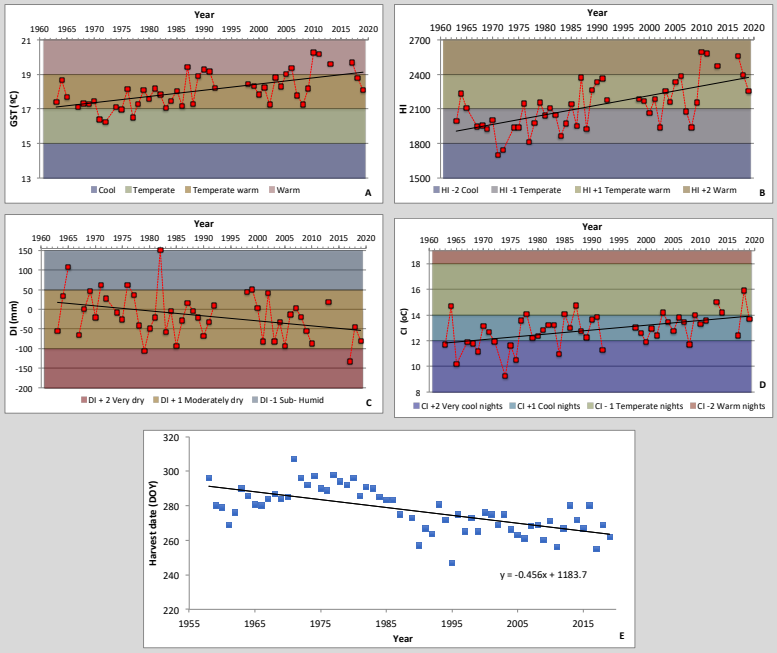

Figure 2. Trends over time (1958-2019) of the bioclimatic indices, (A) Growing season temperature (GST), (B) Huglin index (HI), (C) Dryness index (DI), and (D) Night cold index (CI), and (E) harvest date.

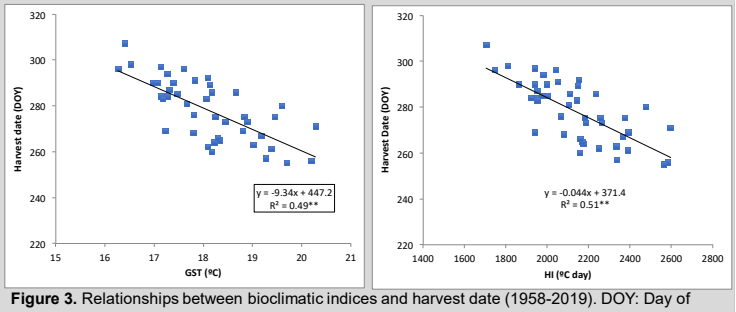

Figure 3. Relationships between bioclimatic indices and harvest date (1958-2019). DOY: Day of year

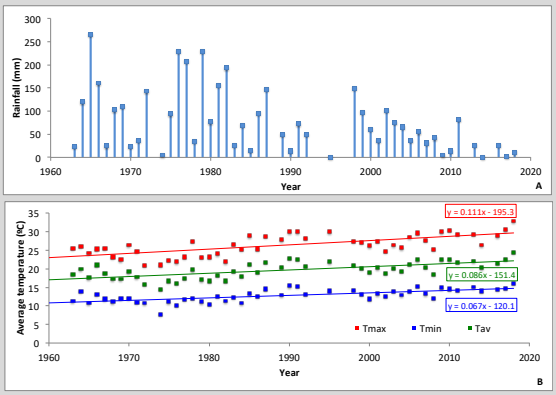

Figure 4. Trends over time of the accumulated rainfall (A) and average temperature (B) during the ripening period (1958-2019).

TAKE HOME MESSAGES

The trends over time for the classical temperature-based indices presented a significantly positive slope while the Dryness Index (DI) showed a negative trend over the last 61 years. Regarding grapevine phenology, an average advance of 4.5 days per decade in the harvest day was observed throughout the last 61 years. Consequently, the weather conditions during the ripening period have changed, showing an increasing trend over time in the average temperature (higher magnitude in the maximum than in the minimum temperature) and a decrease in the accumulated rainfall. The regression analysis showed that ~50% of harvest date variability over years was explained by the temperature-based indices variability.

These observed effects of climate change on bioclimatic indices and corresponding anticipation of harvest date can still be considered advantageous for the Dão terroir as it allows to achieve an optimal berry ripening before the common equinox rains and, therefore, avoid the potential negative impacts of the rainfall on berry health and composition.

LITERATURE CITED

Huglin, P. (1986). Biologie et écologie de la vigne (Paris: Payot Lausanne), 375 pp.
Jones, G.V., Duff, A.A., Hall, A., and Myers, J.W. (2010). Spatial analysis of climate in winegrape growing regions in the Western United States. Am. J. Enol. Vitic. *61*, 313–326.
Riou et al. (1994). Le Déterminisme Climatique de la Maturation du Raisin: Application au Zonage de la Teneur em Sucre dans la Communauté Européenne (Luxembourg: Office des Publications Officielles des Communautés Européennes), pp.322.
Tonietto, J., and Carbonneau, A. (2004). A multicriteria climatic classification system for grape-growing regions worldwide. Agric. For. Meteorol. *124* (*1-2*), 81–97.