COASTAL CLIMATES AS AGENTS AGAINST CLIMATE CHANGE IN SOUTHERN URUGUAYAN VITICULTURAL REGIONS

Ramiro TACHINI[1,2], Valerie BONNARDOT[2], Hervé QUENOL[2], Mercedes FOURMENT[1]

1. Facultad de Agronomía, Universidad de la República Oriental del Uruguay. Av. Garzón 780, CP 12900 Montevideo, Uruguay
2. Université Rennes 2, LETG-UMR 6554 CNRS, 2 Place Recteur Le Moal, 35 043 Rennes Cedex, France
rtachini@fagro.edu.uy

Le climat côtier comme agent d'atténuation du changement climatique dans les régions viticoles du sud de l'Uruguay

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Keywords: viticulture, climate change, sea breeze, berry composition, Uruguay

Introduction

Climate is one of the main elements of the terroir that conditions the quality and quantity of wine production (Van Leeuwen & Seguin, 2006). Hot summers, mainly with numerous hours above 30°C, cause rapid grape ripening, resulting in wines with high alcohol content, low acidity and poor aromatic performance (Blancquaert *et al.,* 2018). Due to global warming, hot summers and spring frost risk are becoming increasingly recurrent in different parts of the world, directly affecting wine production worldwide. This has led the global wine industries to search for new sites offering better conditions for grapevine growing (Santos *et al.,* 2020). This work aimed to assess the response of two vineyards in climate contrasting sites on the Uruguayan coast during 2023 vintage, a hot summer.

1. Material and methods

Two vineyards were selected: the first one in Southern Uruguay, Canelones (C) (a traditional wine-growing region, 25 km from the estuary of the Rio de la Plata) and the second one in Eastern Uruguay, 200 km to the east and 20 km from the Atlantic Ocean near Pueblo Garzón (O). At each site, meteorological stations recorded agroclimatic parameters over a 32-year period during growing seasons (GS). To study the 2023 GS, a Tiny Tag Data Logger temperature sensor were installed in 14 plots of Tannat and Albariño cultivars (7 in each cultivar). Twelve of the sensors were located in the O region, including 6 located at high elevation (H) exposed to oceanic winds and 6 located at lower altitude and more sheltered from sea wind circulation (L). The remaining 2 sensors were installed in C, on flat terrain. Based on data from weather stations and temperature sensors, bioclimatic indices adapted to grapevine cultivation were calculated, as Growing Degree Days, Temperature average during the growing season (from 1st sept. to 15th March), Huglin Index, and Number of hours above 30ºC, 35°C and 40°C as a threshold for grapevine physiology activity. We also quantified sea breeze events. For that, we measured the temperature decrease at the time of daily maximum temperature (between 12 pm and 16 pm local time) and classified it into three categories of intensity (0.5°C, 1°C and 1.5°C of decrease). In order to study the Tannat and Albariño responses to local and seasonal climate conditions, weekly measurements of grape composition during the ripening period were made until harvest.

2. Results

Based on climatic data from the weather stations of the past 32 GS, there were no significant differences between regions C and O in terms of the GS mean temperature and thus cumulated degree days; two parameters that are commonly used to assess climate potential of region for viticulture and/or to select the best suited varieties for planting (Jones, 2006). However, significant statistical differences were observed in the minimum and maximum GS temperature, the thermal amplitude of the ripening period, the Cool Night Index, the Huglin Index and the maximum summer temperature. On average, the summer in the Atlantic coast (O) is 2°C cooler than in the traditional region of the Rio de la Plata estuary (C). At both sites, the 2023 GS was the warmest growing and grape ripening seasons of the past 32 years. The average GS temperature was between 1.3°C and 1.5°C above average, while the summer maximum temperature was between 1.7°C and 1.5°C above average, for O and C respectively. At the vineyard level (meso-climate temperature sensors), the 2023 summer maximum temperature was 3.2°C higher in C than in O. In C, more than 343 hours above 30°C (of which 119 hours above 35°C) were recorded compared to O. Temperature reached 40°C and beyond 10 times at C, while this severe and stressful thermal threshold for vineyard was not reached at O. Within the O region, plots at high elevation showed a maximum

difference of 90 hours less with temperature above 30°C and 10 hours less above 35°C compared to lower sites. A greater frequency of sea breeze circulation was recorded in O than in C (42 more events with a 0.5°C decrease, 20 more events with a 1°C decrease and 26 more events with a 1.5°C decrease. Within the O region, the high elevation sites had an average of 13 more events with a 0.5°C decrease, 9 with a 1°C decrease and 4 with a 1.5°C decrease compared to sites at lower locations. Specifically for a heat wave period (9- Feb to 12-2 Feb), Figure 1 shows the evolution of the temperature on mean sensors in C, H and L during the grape ripening period. These climate conditions impacted grape ripening resulting in Tannat (Albariño) being harvested 15 days (10) earlier in C compared to O. Regarding grape composition, in C, Albariño presented 0.9° more probable alcohol, and Tannat 1.3° more on average compared to O. Within O, plots at lower elevations presented a greater alcohol potential of 0.1° more in Albariño and 0.7° more in Tannat compared to cooler plots at high altitude facing the Ocean influence. As for total acidity, Albariño was 3.2 g/L and Tannat 1.4 g/L more acidic in O than in C Within O, Tannat and Albariño's grapes from the cooler plots were more acidic by 0.7 g/L.

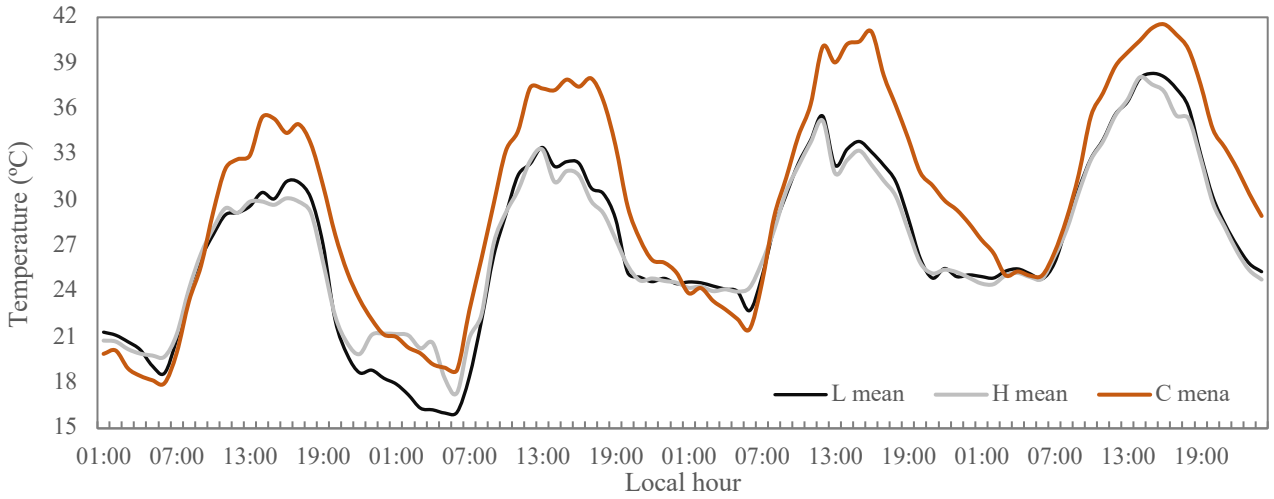

Figure 1. Temperature evolution during a heat wave during the grape ripening period (9-Feb to 12-Feb) for the mean of the sensors in L, H and C.

Conclusion

In the context of increasing frequency of hot summers (IPCC, 2021), the search for new cooler terroirs becomes a concern for obtaining balanced quality products. In this way, the Atlantic Ocean and its influence, particularly the development of sea breeze air circulations during hot summer days, becomes relevant to face the increasing frequency and intensity of extreme events caused by climate change. Within the global climate change context and regional impacts, this study resulted in the identification of an area with a high oenological potential, which is relevant for the country's medium- and long-term production.

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