EFFECT OF CLIMATE CHANGE ON THE AROMATIC PROFILE OF PINOT BLANC: A CASE STUDY OF SOUTH TYROL

Selena TOMADA[1*], Martin ZEJFART[2], Fenja HINZ[2], Valentina LAZAZZARA[3], Peter ROBATSCHER[3], Ulrich PEDRI[2], Florian HAAS[1]

[1]*Department of Viticulture, Laimburg Research Centre, BZ, Italy;* [2]*Department of Enology, Laimburg Research Centre, BZ, Italy;* [3]*Laboratory for Flavours and Metabolites, Laimburg Research Centre, BZ, Italy.*

*Corresponding author: selena.tomada@laimburg.it

Introduction

The global climate change has led to an average temperature increase of about 1.1°C in the Alps over the last century (Böhm *et al.,* 2001). This event could have detrimental effects on grapevine phenology, berry ripening processes and aromas development within the alpine ecosystem (Alikadic *et al.*, 2019; van Leeuwen & Darriet, 2016). In this regard, it was observed that a possible strategy to mitigate the drawback of warmer seasons consisted of a general upward shift in elevation of recent vineyard plantings in South Tyrol (Vigl *et al.*, 2018).

The study aimed to evaluate the effects climate change on grape phenology and berry juice composition of cv. Pinot Blanc grown in the viticultural region of South Tyrol and to hypothesize the possible changes that have occurred over the recent decades in the aromatic profile of Pinot Blanc wines produced in this area.

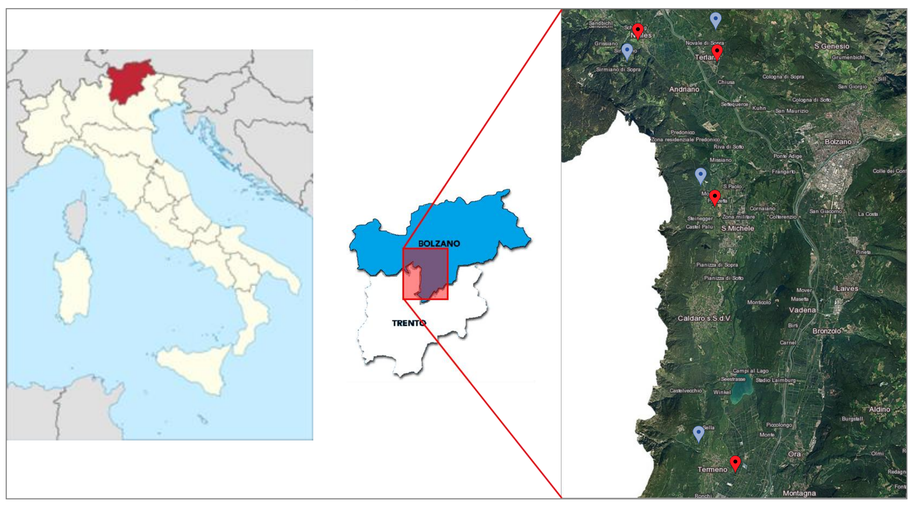

Figure 1: Selected Vineyards. The study was carried out in South Tyrol (northern Italy). The eight vineyards were located along the Adige Valley. Red points indicate vineyards of thermal regime 1 (low-altitude), blue points indicate vineyards of thermal regime 2 (high-altitude)

Materials and methods

- **Historical data analysis:** Ripening data (1985-2014) collected from Pinot Blanc vineyards in the municipality of Terlan (278 m.a.s.l) were analyzed together with local meteorological data from the same period.
- **Changes in the aromatic profile of Pinot Blanc:** Eight Adige Valley vineyards of varying altitudes were selected for the current study and can be divided into two groups: thermal regime 1 (low-fields, 223-500 m.a.s.l) and thermal regime 2 (high-fields, 551-730 m.a.s.l) (Fig. 1). Climatic data were collected from each vineyard site during the vegetative period (April to October). Grapes were harvested at common total soluble solid concentration (18° Babo) and processed using a standard vinification protocol. The oenological parameters of must and wine were analyzed by FT-IR technology. The wines were subjected to sensory analysis by a trained panel of tasters (Fig. 2). Before statistical analysis, the sensory attribute data were elaborated and corrected for outliers.

Figure 2: Experimental process. Grapes were grown and harvested. Grape juice was extracted and processed by a standard vinification protocol. Wines were subjected to a sensory panel test.

Results

Historical data analysis

In the historical viticulture area of Terlan the average temperature of the grapevine vegetative period (April-October) has risen about 0.8°C over the period 1985-2014 (Fig. 3).

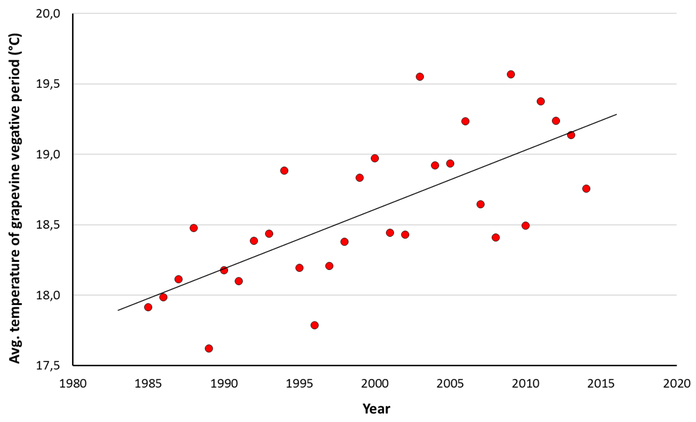

Figure 3: Average temperature during the grapevine vegetative period (April-October) from 1985 to 2015, recorded in the municipality of Terlan (Bolzano, Italy).

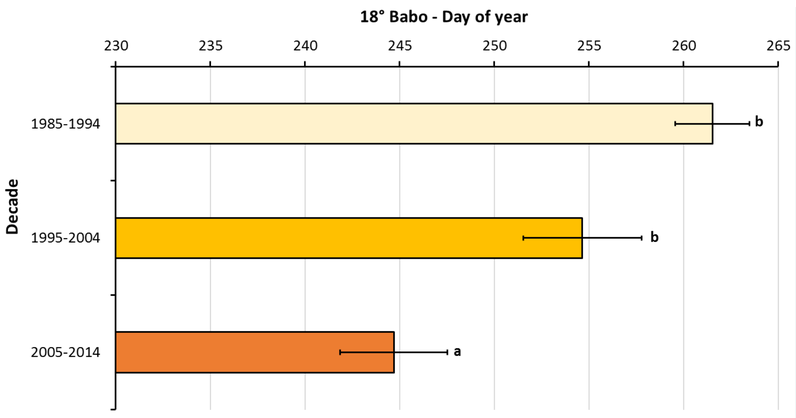

Figure 4: Mean date per decade when the grape juice reached the 18° Babo degree. Different letters indicate significant differences according to Tukey´s test (α=0.05).

Increasing temperatures have affected grapevine phenology and a more early harvest date was recorded during the last thirty years. A common total soluble solid content of 18° Babo has been reached at the 261st and 244,7th day of year (DOY), in 1985-1994 and 2005-2014 decades, respectively (Tab. 1; Fig. 4).

The observed slight decrease in grape juice malic acid content at harvest date, with lowest concentration recorded during the period of 2005-2014 compared to 1985-1994, is consistent with the overheating phenomenon (Tab. 1).

Decade	18° Babo DOY	pH	Titratable acidity (g/L)	Tartaric acid (g/L)	Malic acid (g/L)
1985-1994	261,5 ± 6,2 [b]	3,2 ± 0,1 [a]	6,5 ± 0,9	4,6 ± 1,1 [a]	3,4 ± 0,9
1995-2004	254,7 ± 9,9 [b]	3,4 ± 0,0 [a]	6,7 ± 0,6	5,9 ± 0,6 [b]	2,7 ± 0,7
2005-2014	244,7± 9,0 [a]	3,3 ± 0,1 [ab]	6,5 ± 0,8	6,6 ± 0,9 [b]	2,5 ± 0,7

Table 1: Composition of Pinot Blanc grape juice from three decades from 1985 to 2014. Different letters indicate significant differences according to Tukey´s test (α=0.05).

Aromatic profile

The two groups of vineyards were characterized by two different thermal regimes (TR) and were chosen to represent the effects of climate change occurred during the last decades in the plain of Adige Valley (Tab. 2).

Table 2: Thermal regimes of the two groups of vineyards (low- and high-altitude). The average temperature of the vegetative period (April-October), berry development period (cluster closure to maturity), bloom to veraison and veraison to harvest periods.

		Average Temperature (°C)			
Thermal regime	Vineyard altitude	Vegetative period (Apr-Oct)	Berry development period	Bloom-Veraison	Veraison-Harvest
1	Low	18,6 ± 0,8	22,2 ± 1,2	22,1 ± 0,6	22,3 ± 1,6
2	High	17,1± 0,5*	20,1 ± 1,4*	21,2 ± 0,4*	18,9 ± 1,2*

The preliminary data (vintage 2017) show that the wines of TR1 (cooler, high-altitude) are characterized by sourness and peach flavour. However, more complexity and general appreciation were given to the wines characterized by banana aroma corresponding to the warmer of the two thermal regimes (TR2, low-altitude) (Fig. 5).

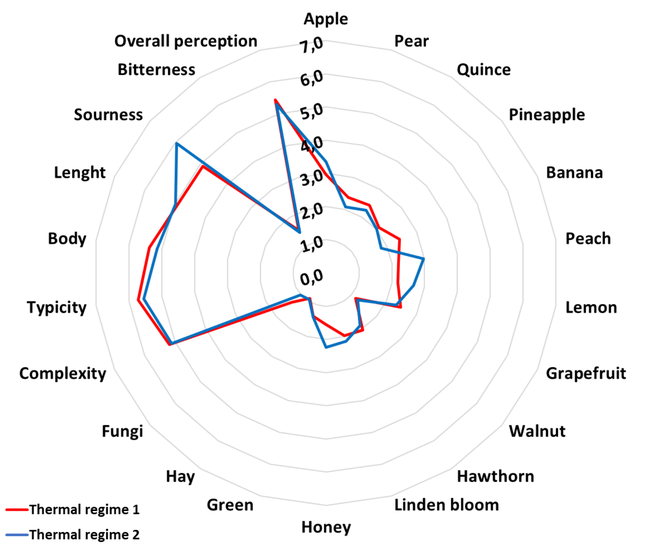

Figure 5: Radar graph of aromatic and hedonistic parameters for the two thermal regimes (TR): TR 1 (red line) represents the warmest TR corresponding to low-altitude vineyards, TR 2 (blue line) represents the coolest TR corresponding to high-altitude vineyards. Each value is the mean of the data coming from three sensory panel sessions.

According to the average temperature of the berry development period, the aromatic profile of Pinot Blanc cultivated in the plain of the Adige Valley during the last thirty years will likely switch from fruity fresh notes to tropical fruit flavours (Fig. 6).

Figure 6: Hypothesis of the effect of increasing temperature during berry development period on the aromatic profile of Pinot Blanc wines. Pink spots indicate prevalence of peach flavour, while yellow spots indicate prevalence of banana flavour.

Conclusion – Climate change that has occurred in the Alpine viticultural region of South Tyrol has triggered earlier grape harvest times, meaning that berry development occurring during warmer periods may result in changes to the style and aromatic profile of Pinot Blanc wine, from fruity-fresh notes to tropical aromas. However, further studies would be necessary to understand how much climate change could affect the aromatic composition of South Tyrolean Pinot Blanc wines in the near future.

Acknowledgments

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