Garda DOC Agroclimatic situation



Osvaldo Failla

Historical background

- In the Garda doc area, the **domestic vine** has been cultivated since the Iron Age.
- The **remote consumption of wild grapes was also likely**, since the southern area of the Alps was an important refuge for wild vines during the last glaciation.
- Early consumers: the Neanderthals and Homo sapiens who left some of the oldest traces of their presence in Italy in this area (Fumane Cave).

Current wild grapevine distribution (Grassi et al., 2006). In red the mountain ranges whose southern slopes served as shelter areas during the ice ages



Grassi et al., 2006. Phylogeographical structure and conservation genetics of wild grapevine, December 2006, Conservation Genetics 7(6):837-845

At the roots of vineyard climate - flows of matter and energy





Through these flows, the vineyard exchanges matter and energy (water, heat, radiation) with the entire planet (Lorenz's butterfly effect).



From these incessant flows, which are turbulent in nature, arise the atmospheric variables (temperature, humidity, wind, radiation, rainfall, etc.) that, viewed over long periods of time (decades), give rise to climate.

Edward Lorenz (1918-2008)

The factors that modulate the climate of the Garda doc area

MID-LATITUDE LOCALISATION

with characteristic air masses and circulatory structures



LOCALISATION IN THE PO ALPS REGION

Basin bordered by the Alps and the Apennines, open east to the Adriatic Sea



EFFECT OF THE ELEVATION lay of the land, slope, exposition



EFFECT OF LAKE GARDA AND MEDITERRANEITY



LAKE EFFECT

-Solar radiation: fewer foggy days in winter. Reflective effects on the surface.

- Relative humidity: mitigated by breezes;

Temperature: extreme temperatures are mitigated, as coastal areas experience higher temperatures in winter and lower temperatures in summer

- Winds: lake and mountain-valley breezes that stir the air mass mitigate the levels of relative humidity.

MEDITERRANEITY

Garda has an **attenuated Mediterranean character**, attested by the flora but dampened by excessive summer rainfall for the climate to be considered fully Mediterranean -> **insubric mesoclimate**.

Lake and fog effect (photo: ESA)

Envisat satellite image, acquired by the Medium Resolution Imaging Spectrometer (MERIS) instrument on **19 January 2010**, captures fog cover over the Po Valley in northern Italy and snow cover over the Alps https://www.esa.int/Applications/Observing_the _Earth/Earth_from_Space_In_the_mist

Mediterraneity - the climatic diagram of Bagnouls and Gaussen





Data from weather stations as an interpretative tool

The combined action of these phenomena produces the **atmospheric variables in the vineyard** (cloudiness, temperature, humidity, wind, precipitation, etc.) which are measured by weather stations. **The map shows the 14 weather stations in the DOC territory.** Other additional weather stations in the bordering area are not on the map. The **variables measured by the stations** are spatialized to the entire territory in order to obtain a value for each 50x50 m cell (a quarter hectare).



Stazione	acronimo	Longitudine	Latitudine	altezza
Calvagese	CALV	1612357	5043322	210
Dolcè	DOLE	1644210	5051242	105
Grezzana	GREZ	1657307	5041581	156
Lonato	LONA	1619777	5031635	150
Marano	MVLP	1650168	5045646	296
Puegnago	PUEG	1619456	5048354	142
S.Giovanni Ilarione	SGIL	1674000	5046287	320
San Giovanni Ilarione 2	SGLA	1674294	5042229	269
Sirmione	SIRM	1626584	5034807	59
S.Pietro in Cariano	SPIC	1647514	5041286	130
Tremosine	TREM	1635106	5073883	414
Valeggio_sul_Mincio	VASM	1636013	5023763	120

WHAT REFERENCE PERIOD?



Mariani L., Zavatti F., 2017. Multi-scale approach to Euro-Atlantic climatic cycles based on phenological time series air temperatures and circulation index, Science of the Total Environment 593–594 (2017) 253–262

Synoptic Station of Verona Villafranca (1951-2020)



Annual average temperatures

Total annual precipitation

Reference period 2001-2020





General climatic framework

Temperature medie annue - °C (media 2001-2020)



Temperatures in the wine-growing region range from 10 to 16°C





In yellow are the isohyets of 1000 and 1250 mm

Short climatic classification of the Garda Doc area



Subcontinental temperate climate*, characterised by :

- Average annual temperatures between 10 and 14.4 °C;
- Average of the coldest month between -1 and 3.9°C;
- 1 to 3 months with average temperatures above 20°C;
- Annual temperature range (difference between average temperature of the coldest and warmest month) of more than 19°.

(*) Koeppen's classification as modified by Mario Pinna for the Italian area (Pinna M., 1972. La climatologia, UTET, Torino)

Viticultural climatology

RADIATION RESOURCES - annual potential PAR (MJ m-2)



From more than 4000 MJ m-2 for the best-exposed areas to values below 1000 in the less exposed areas

HEAT RESOURCES (Huglin's index).



1600000 1610000 1620000 1630000 1640000 1650000 1660000 1670000 1680000 1690000 1700000 From more than 4000 MJ m-2 for the best-exposed areas to values below 1000 in the less exposed areas

Heat stress



Only mid-late maturing grape varieties are concerned

Post-veraison water stress (early maturing grape varieties)



Only early maturing grape varieties are concerned

Agroclimatic-based zoning

Suitability model

- The suitability model was defined by describing the effects of heat resources (Huglin degrees) and limitations (heat stress) on the ripening profiles of white and red berry varieties.
- In particular, the following parameters were taken into account:
- the effects of heat on the dynamics of sugar accumulation and acidity degradation (technological maturity) and, for red grape varieties, on the dynamics of phenolic maturation in terms of anthocyanin accumulation and tannin evolution in the skin and seeds
- the potential aromatic profiles of wines according to the most common olfactory descriptors.

Agroclimatic suitability map



What the map tells us

Five areas suitable for varietal wines of different styles to best express the characteristics of each variety.



Zones 1 and 2: higher heat that induces summer stresses which favour mid-late maturing grape varieties to be used for the production of structured, long-lived wines with complex, mature aromatic profiles Zone 3 greater balance between alcohol and acidity and aromatic profile with fresh, spicy, and ripe notes at the same time. Zones 4 and 5: best suited to early grape varieties and to the production of sparkling wines and fresh, floral and fruity wines.

Relationships between western and eastern areas

The map shows that there is no abrupt transition between the western area inside the Lake Garda basin and the eastern area outside the basin.

The similarity between the two subareas is the result of:
homogeneity in heat, rainfall and radiation resources

- circulating breezes that contain relative humidity while limiting fungal diseases and promoting evapotranspiration, which is essential for thermoregulation and for the uptake of carbon dioxide from the air and other nutrients (nitrogen, phosphorus, potassium, etc.) from the soil.