

## HISTORICAL ZONING IN THE WORLD

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### ABSTRACT

The study of the interaction between vineyards and the environment to establish the grapevines in the appropriate places has been applied in wine science for 5000 years. Advances in the field of the zoning have not been uniform in time, and have occupied a preferential place in the contributions of Roman writers of the 1<sup>st</sup> Century AC, the contemplations of Tokay (1700) and Porto (1756) and works of the second half of the 20<sup>th</sup> century. Zoning practices today integrate multidisciplinary methodologies (viticulture, enology, soils, climatology, cartography, statistics, computer science) and require further development for future application.

### KEYWORDS

Zoning – viticulture – world areas -historical

### INTRODUCTION

The current limit of the wine-growing geography of the planet is established by water and temperature restrictions and it is a logical assumption that these factors also determined the initial expansion of the vineyard in terms of the selection of local and wild varieties and the identification of better areas to obtain quality wines.

Fregoni (1998) provides a traditional view of zoning, which he defines as “the research of the territory in order to distribute it in relatively homogeneous zones that ensue from the interaction between the vineyard and the environment”. In the last few years, the focus on this area of research is manifested in the numerous publications that are available and the fact that the International Symposium of wine zoning is celebrating its 8<sup>th</sup> edition this year. The level of knowledge and technological development available at present have allowed for considerable advances in this field through the integration of multidisciplinary methodologies (viticulture, enology, soils, climatology, cartography, statistics, computer science) which are used in a various ways, depending on the authors and on local circumstances (natural conditions, wine typologies, economic and commercial interests, etc.).

### THREE THOUSAND YEARS OF EXPANSION OF THE CROP: FROM SUMERIA (3000 B.C.) TO WESTERN EUROPE

It is likely that the cultivation of vineyards was initiated by the Sumerians when they established themselves in Mesopotamia at the beginning of the third millennium B.C. This practice later spread to the Near East, Egypt and the Mediterranean and finally in Western Europe. In regions where grapevine has been cultivated for millennia an empirical valuation of the possibilities has been carried out over the course of the time, especially in areas where wines achieved a certain reputation. In these areas, the development of a hierarchy of zones can be observed, up to the point of optimizing some *terroir*, with an ideal combination between variety and subzone and the development of a Latin model of viticulture tied to the unique and peculiar characteristics of the area in question. People discovered and valued the

quality of products linking the identity of these to the zone of production, a practice formalized through the development of certain norms and the recognition of the origin. In fact, ancient civilizations already recorded in the amphorae the year and zone of production.

Egyptian documents (paintings, papyruses and statues), very abundant on the subject of the vineyard and wine, references can be found on plants of vineyard led in pergola and the harvest as well as the elaboration of the wine. In the Nile region, where the landscape is completely flat, artificial hills, directly exposed to the sun were created because they were already conscious of the importance of this exposure in the development of the grape. In the texts of the pyramids of the Pharaoh Some (2.423 B.C.) reference to four types of wine that relate to the areas of production can be found: from the North, Abesh's wine, Buto's wine and Hamu wine. In other sources make reference to different types of wine of the vineyards of Lower Egypt, Upper Egypt and the oasis of the west. The geographical classification of the list of Abidos, based on the four cardinal points, divides them in wine of the North, Anit's wine; in the zone of the delta, Hamet's wine; in the west, Mareotis's zone; and Syene's wine, in the south. There are also references to wines of Libya, Greece, Phoenicia and Palestine.

The Phoenicians and the Greeks contributed different varieties and technologies of cultivation (low forms) in the expansion towards the western Mediterranean, which allowed for the adjustment to dry areas. During the Roman period the interest in grapevine grew and the wine-growing technologies were improved both by own contributions and by the abundance of Asian and Greek settlers. The Romans expanded the vineyards towards the north and the west, reaching places where their cultivation is no longer practiced (Great Britain). It is likely that this expansion took place while keeping in mind the sufficient accumulation of heat and the duration of the cycle for the ripeness of the grape, as well as the absence of cold weather in the winter, likely to kill the plant. The vineyards adapted to the local conditions both in flat areas (Galias) or on slopes that took advantage of the best exposure to the sun (Germany, west of Spain).

### **INNOVATIONS IN ZONING FROM I BC TO II AD**

Between the 1<sup>st</sup> Century BC. and 1<sup>st</sup> Century AD viticulture reached its heyday, as is revealed in the numerous agricultural agreements (Catón, Columela, Horace, Plinio Old, Virgil, etc) in which special treatment was given to viticulture and prescriptions were made as to the characteristics and favorable conditions for the production of quality grape. The authors studied the vineyard in the Mediterranean basin and provided a detailed description of the varieties of vineyards, the characteristics of the wine, the places and the traditional and cultural skills and techniques related to the vineyard, The prominence of the role of the environment stood out at the macrozone (Etruria, Campania..) as well as at the microzone level. Catón, for example, indicates the importance of the choice of the area (exposure to the Sun, fertility of the soil) depending on the variety (vigor, quality) to be planted. Virgil in his Georgicon analyzes the differences between Greek and Italian wines and emphasizes the characteristics of the soils most adapted to the different varieties. In the same work he closely analyzes the different elements of the *terroir*: the soil (how to choose the soil depending on the cultivation, those with more clay are more adapted to wheat whereas lighter soils are more appropriate for the vineyard), the position (the vineyard prefers expose hills and it is necessary to decide if it is more suitable to plant in a plain or on hill) and the exposure.

Columela insists on these elements of the *terroir*, considering exposure of prime importance, and analyzes, in a comparative way, the thoughts of numerous authors: “there is an ancient dispute on the part of the sky which the vineyards should view. Saserna prefers the

orientation to the east, first; then at noon; finally to the west. Tremelio Scrofa recommends exposure at noon. Virgil decidedly disapproves exposure to the west: "and may your vineyards not look at the sun that goes down." Demócrito and Magón ponder the great value of the northern exposure, as this will make them very productive even if they are surpassed in relation to the quality of the wine. Columela himself recommends that, in cold places the grapevines should look at the midday, and in the lukewarm areas to the east, granted that they are not molested by the winds of Austro (the wind of S) or Euro (wind of E); if the regions are punished by these winds it is better to orient them toward the Aquilon (wind of the N-NE) and the Favonio (wind of O), and in the very warm provinces, such as Egypt and Numidia, only towards the north".

Columela indicates that the first aspect to bear in mind when establishing a new vineyard is the choice of location, which must be based on an analysis of the climatic characteristics of the environment. He also analyzes the characteristics of the different soils: of the plains, hills and mountains and, in each case, thick or thin, free or compact, humid or dry. The different combinations of these give rise to many soil varieties, which he describes in terms of their possibilities and the most appropriate varieties for the soil and climate in question as well as the necessary preparatory tasks. He then details the different cultural technologies and the characteristics of the varieties.

Plinio the Old places importance on the choice of "situs vinearum" and offers information on the effect of climate, orientation, exposure and soils on yields and quality of the grapes in relation to the different varieties. He established a distinction, depending on the altitude, between vineyards of the plain, of hillsides and of mountains; one region can thereby be the origin of very different wines. In this regard he points to the example of Campania's where close to peak of the hills of the Massico, Caucin, a light wine was produced, whereas lower elevations produced Faustian, a sweet wine, and the foothills were home to a well-constituted wine that was known as Falerno. The first zoning mentioned in the history is that of Falernum (Plinio s. I B.C.), which established a geographical and territorial delimitation: "this entire zone of the Campania that spreads from the bridge of Campanus for those who go from the left side to the urban colony of Chair is full of hills with vineyards famous for the generous wines that take the name of Falerne's villa" (Naturalis Historia, book 14, chapter V).

### **NEW IDEAS ARISE WITH HUMANISM (The XIVth Century)**

The Middle Ages (V to XV AD) brought about a delay in the development of grapevine, due to invasions in the northern and southern Mediterranean, and because of political and economic crises. The religious orders established monasteries in diverse European regions where they introduced the knowledge on vineyards acquired in other areas and regions, aiding in the local development of wine growing.

At the end of the Middle Ages, with the beginning of the humanism, the Bolognese Pietro Di Crescenzi wrote his treatise "On the grapevines and vineyards, their cultivation, nature and utility of their fruits." This occurred around 1304 and he compiled not only the knowledge of the time but also earlier foundations of the cultivation of vineyard and of wine in the western world. Di Crescenzi's book meticulously reflects the knowledge acquired by vine-growers and wine-producers of the 14th century; in this era it was not frequent to move wine large distances from the place of production: the expansion of the culture of wine was primarily due to the extension of its cultivation, thanks in part to the monastic orders. One of the most interesting aspects of the book refers to the establishment of new plantations as it discusses accurately discusses the climate and appropriate place and makes recommendations

as to the exposures of terrains, types of varieties - some of which continue to be used today-, and forms of cultivation for different situations. For several chapters there are precise indications, some of which are of current relevance, which include the effects of different types of soils, depending on the previous cultivation practices, and of the operations, labor tasks and actions to establish a new plantation. These ideas are further developed during the Renaissance in the two centuries after Di Crescenzi.

### **BEGINNING OF THE MODERN AGE**

The beginning of the Modern Age contributes to establish an order in viticulture zoning. In Hungary, in 1641 a law was established for the Tokaj-Hegyalja's district, which regulated vineyard site selection, the construction of terraces, irrigation, application of manure, and hoeing (which had to be done for the last time on 20 August before the official harvest date of 28 October). In 1660 the “noble rot” was recognized and a norm for the elaboration of the Aszu was established. In 1700 a classification of the vineyards was completed and the zones of production were officially documented.

In 1756 the Marquess of Pombal, Prime Minister of Portugal, developed the first wine-growing region denomination of the world, in the valley of the Douro. Specific areas of production of the wines for export were defined, within these, vine-growers obtained higher prices than those vine-producers in other regions. The area's region has been modified several times but has always been based on the region established in 1756.

In the 18<sup>th</sup> century in other European areas, different classifications were established taking into account varying wine qualities and diverse regions as in the case of, for example, Burgundy and Bordeaux in 1787. Nevertheless, in the 19<sup>th</sup> century more formal classifications emerged; Medoc, Graves y Sauternes-Bassac established their lists of crus in 1855.

### **THE 20<sup>th</sup> CENTURY**

At the beginning of the 20<sup>th</sup> century, after the changes imposed by phylloxera, the main problems became adulteration and fraud. As a result, some producer groups promote their own associations to guarantee the origin of their wines and governments formally initiate the geographical delimitation of the areas of production. For example in France, in 1905, a national system of control of wine was created based on the delimitation of areas of origin. In other European countries Germany, Italy, Portugal, Spain, a similar process was developed, leading to the recognition of Names of Origin and their corresponding national associations such as INAO, INDO, etc.

The methods of geographical demarcation vary from one country to the next. One of the most rigorous methods is followed in France for the INAO in which some commissions study the relations between different factors such as geology, soils, topography, drainage, slope, exposure and quality of the wine. The applications are different because in some cases, in Burgundy for example, the geological origin of the soils is a determining factor in the differentiation of the “grandes crus”. The recognition of a product and the belonging of a vineyard to a certain region can have important commercial consequences, which has favored the recent demarcation of the AVAS and IG in America, in Australia and in other countries of the new world, a process which is also observed in other regions of the world. In some cases, this leads to controversy because the historical approaches prescribe varieties and traditional wine-growing techniques that limit innovation for many wine-growers of the new world.

In 1947 a quality evaluation criteria with a method that includes 12 evaluation parameters relative to soil, climate and cultural aspects was established in Douro. The most important elements are: productivity, altitude, terrain, location, and management and account for 81% of the total evaluation. The remaining 19% are the variety, exposure, solid elements in the soils, vine spacing, land shelter and age of the vineyard. The sum of the points determines the classification of the plot (A,B,..). The plots with the highest number of points receive and authorization of benefit (authorization for the production of wine liquor that can be included in the denomination of origin of Porto). According to Moreira da Fonseca (1949) the importance of the production factors are climate (44.2%), plant variety (28.2%) and terrain (26.6%) and production per hectare is determined equally by these three factors.

### **BIOCLIMATIC CHARACTERIZATION AND VINE-GROWING ZONIFICATION**

In distant times, improvements were achieved through simple observations that lead to the emergence of knowledge on environmental influences and, through successive approximations throughout time, vineyards were established. Initially, terrain that offered the necessary conditions for a correct maturation of the grape and capable of producing structured wines with body and with high levels of alcohol and sugars were sought. With time however, more attention has been paid to aroma and acidity. In countries with a more recent development of vine-growing, the rapid expansion of vines and the interest in improving the quality of the product has led to the search for new territories with certain characteristics, such as cooler climate. Especially in the last century, the technical development and the availability of climatic data have contributed to the establishment of numerous bioclimatic indices. Some of these have proven their validity. Especially for the areas for which they were developed but the indications derived can be inadequate for regions in which the vine is cultivated with good results but the type of wine and the aptitude of the variety distort the results. Work on zoning requires precise data of the biological responses of varieties such as, for example, the consideration of a period of higher temperatures with respect to the temperature of sprouting as favorable instead of basing this on the calendar.

Towards the mid 19th century, de Candolle determined that buds began their activity when the average temperature surpassed 10°C and estimated that it was necessary a sum of average temperature in spring in order to reach maturation of the grape. In the 20th century numerous climate indices were developed which have further defined this accumulation of heat (Branas *et al.*, 1946; Winkler, 1962; Constantinescu, 1967; Huglin, 1978; Hidalgo, 1980; Tonietto, 1999; Fregoni and Pezzuto, 2000). These allow for the characterization of vine-growing zones of a country (at the small scale) but are not usable at a larger scale. The new world has made extensive use of Amerine and Winkler but Gladstones (1992) points out that more units of heat accumulation are necessary in order to reach maturation of the grape in Australia and Europe. Smart (1977) and Dry and Smart (1988) use an approximation by homoclimates comparing vine-growing climates of Europe and Australia through a variety of climate characteristics. The vine growing zoning at global macro-climatic level has been developed by Tonietto and Carbonneau (2004). They established a multi-criteria climatic classification on the basis of established classifications for each of the three climatic indices (drought index, DI; heliothermic index, HI; and cool night index, CI), which allows for a consistent climatic classification of regions.



## LARGE SCALE ZONING METHODOLOGY

In the past 50 years, the methodologies for study have been improved and diversified but the development of *terroir* zoning methodology that is truly operation and applicable to vine growing continues to be a delicate issue. This is due to the spatial and temporal variability of certain data on environmental factors (climate-soil) and the multiple variables and complexities of the factors affecting type and quality of wines. Only scientific study can help to analyze the multiple interactions of the environmental system and the vine and allow for the improvement of the tools and their application. This process however is slow due to the areas of grape-vine that are to be characterized, the volume of data to gather and process and the cost of this.

Vine-growing area zoning has developed in many countries with a view to defining and characterizing the potential offered by vine-growing ecosystems. Some authors have analyzed the climatic determinism in the maturing process of the grape at European level (Caló *et al.*, 1992; Riou *et al.*, 1994); although the zoning, at small scale, correctly reflects the deviations between sugar contents of the large climatic regions, they do not yet reflect the regional differences at country level. Carbonneau (1994) analyzed some aspects of European Atlantic vine-growing and showed that this unit of analysis masks large climatic disparities, in addition to the variability within the *terroir* of each region. Similarly, Fregoni (1994) studies various Atlantic vine-growing regions of Africa, America and Europe and showed that a large diversity of climates exists and suggests the use of available climatic indices in order to increase the knowledge on the relationship between climate and vines.

Other authors have approached the subject based on the study of the interaction of genotype and natural environmental factors (climate, geology, pedology): (Astruc *et al.*, 1980, Morlat and Asselin, 1993; Riou *et al.*, 1995). Falcetti (1994) and Deloire *et al.*, 2005, demonstrate a global focus on the responses and problems of delimitation of the *terroir*.

## CONCLUSIONS

At the end of the 20th century, Fregoni (1998) defined zoning as study of territory with the objective of dividing it in relatively homogenous zones that result from the interaction of the vine and the environment. This definition summarizes the concept of treatment of the areas dedicated to the vineyard, which have been applied to the vine-growing science for 5000 years. The advances in the area of zoning have not been uniform throughout history. Zoning practices today integrate multidisciplinary methodologies (viticulture, enology, soils, climatology, cartography, statistics, computer science) and require further development for future application.

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