

**SYNTHESIS OF THE CONTRIBUTION OF THE GiESCO
(Group of *international* Experts of vitivinicultural Systems for CoOperation)
TO THE STUDY OF TERROIRS**

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ABSTRACT

Since 1998, the GiESCO (previously named GESCO: Groupe d'Etude des Systèmes de CONduite de la vigne) has provided the scientific community with relevant contributions to the study of terroirs. Here is a synthesis of the main terroir-related fields and the major ideas the GiESCO has developed: Basic Terroir Unit and climate, Vine Ecophysiology and microclimate – moderate drought, Vineyard heterogeneity and new technologies, Viticultural Terroir Unit and canopy management, Terroir – Territory and man.

KEYWORDS

Terroir, Basic Terroir Unit, Viticultural Terroir Unit, territory, climate, soil, Ecophysiology, microclimate, water limitation, new technologies, canopy management, training system, cultivation techniques, wine quality, economics.

INTRODUCTION

The name of 'Terroir' has a double origin:

- Latin as '*territorium*', which means an identified and controlled space,
- French as 'Terroir', which means a region giving original natural products.

The concept of Terroir was used for many purposes: to guarantee the authenticity of products against frauds, to justify an economical advantage linked to a specific property, to synthesize an historical local experience, to strengthen the defence of a community of growers facing economical competition, to explain the characteristics or the typicity of the wines.

Quite recently, around the 1980's, a scientific approach of Terroir was developed by several teams and led to establish some relations between some elements of the natural environment and some of the wines. At that stage, geology and soil were considered as the major components of the Terroir. On such basis, new scientific developments on Terroir occurred, and the GiESCO was concerned about 1998. The main contributions of the group (CR GiESCO and GiESCO/OIV; Carbonneau et al., 2007) are summarized as follows.

BASIC TERROIR UNIT (BTU) AND CLIMATE

Key idea: Climate is dominant and interacts with the soil and the subsoil.

It appears that many vine responses to physical environment were dependant both on soil and on climate, particularly when dealing with the soil water availability. That led to the concept

of interaction “mesoclimate x soil/subsoil” which was named Basic Terroir Unit (Carbonneau et al., 2007). The progress in vineyard climatology opened new ways to study terroirs (Tonietto, 1999; Tonietto and Carbonneau, 2004). With the possibility to work on a macroclimate scale of viticultural regions worldwide and monitoring the climate change impact on viticulture, the Géoviticulture MCC System is a tool at the BTU scale. It allows the characterization of viticultural potential of the BTU for helping its management. Using three climatic viticultural indices – Heliothermal index, Cool night index and Dryness index, the system makes possible to study the interaction of “mesoclimate x soil” and its relation with the plant and grape quality, including the vintage effect. It can be optimised with specific climatic variables for a particular BTU. The methodology, examples of use and bibliography of the system are available in the site www.cnpuv.embrapa.br/ccm.

VINE ECOPHYSIOLOGY AND MICROCLIMATE – MODERATE DROUGHT

Key idea: Microclimate is the real environment and water limitation the main regulation.

Many cultural methods will modify the interaction of the plant with the environment. These interactions are extremely complex and exist on several organisational levels. Most important are micro-climatic effects (Carbonneau et al., 2007; Smart, 1976) near the fruiting zone and whole-plant responses (Carbonneau, 1980, 1995; equilibrium ‘Exposed Leaf Area – Production – Vigour’: Carbonneau et al., 2007) which can be modified by viticultural decisions with respect to row orientation, canopy form or architecture (new modelling is under development: Louarn et al., 2005).

Water relations in this context seem most important but can not be completely separated from temperature and light. For example leaf drop initiated by water deficit will alter temperature and light conditions around the fruit. The challenge with respect to research is to quantify these effects on key quality components in order to deduct viticultural strategies to optimise the interaction between plant, soil and climate. The concept of moderate water limitation during grape berry maturation, as optimal for berry and wine quality, was validated. More, that situation appeared to correspond to maximum terroir expression into wines.

The following works on all those aspects need to be cited as examples of all those aspects: Bondada and Keller, 2007; Carbonneau, 1980, 1995, 2000, 2004; Carbonneau et al., 2006, 2007; Carbonneau and Bahar, 2009; Kliewer, 1977; Ojeda, 1999; Palliotti et al., 2007; Schultz, 1995; Smith et al., 2007; Wang, 2003.

VINEYARD HETEROGENEITY AND NEW TECHNOLOGIES

Key idea: Environment is basically heterogeneous and measurable by new technologies.

The collection of high-resolution spatial information on crop production is now possible in Viticulture. This information includes measurements of the local environment, including soil, canopy growth and the final quantity (fig.1) and quality of production. Tools and methods are now available or under development to characterize the heterogeneity of the vineyard. They allow a detailed knowledge of systems of production which are difficult to obtain with the classic methods of measurement. Information on the spatial structure of production variation is of importance as it provides an idea of how site-specific management may be applied to a particular field with the objective to control both the yield and grape quality of harvest.

Knowing that heterogeneity, one may use it for producing separated specific wines, even from the same plot, or for blending and increasing wine complexity.

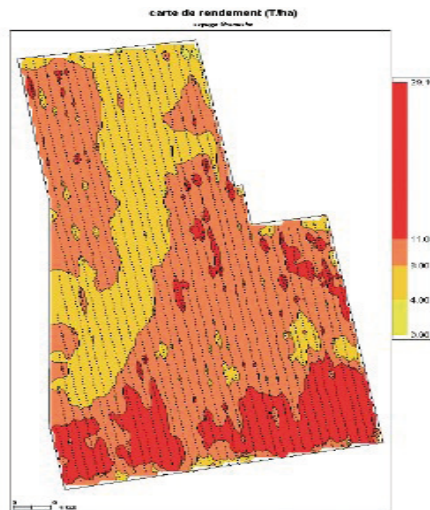


Figure 1. Map of yield recorded at the approximate level of individual vines, of an heterogeneous plot at INRA Pech Rouge Experimental Unit (Montpellier, France). Notice the existence of 3 different zones, and the possibility to harvest the bottom one separately.

VITICULTURAL TERROIR UNIT (VTU) AND CANOPY MANAGEMENT

Key idea: Canopy management and architecture are part of Terroir and wine typicity.

The diversity of architectures was described by Carbonneau and Cargnello, 2003). Particular training systems were created and studied to complete the traditional choices (Carbonneau, 1980, 2009; Carbonneau and Cargnello, 2003; Carbonneau et al., 2008; Castro et al., 1996; Clingeffer, 1999; Shaulis et al., 1966).

Numerous trials on training systems and canopy management were performed and presented by the GiESCO on physiological or technical aspects, among them it was possible to check that the canopy architecture interacts with the environmental factors to determine terroir expression into wines (Carbonneau, 2000, 2004; Carbonneau et al., 2006, 2007). This was the occasion to deepen studies on wine sensory analysis and typicity in relation to berry maturation (Fig.2; Carbonneau, 2007).

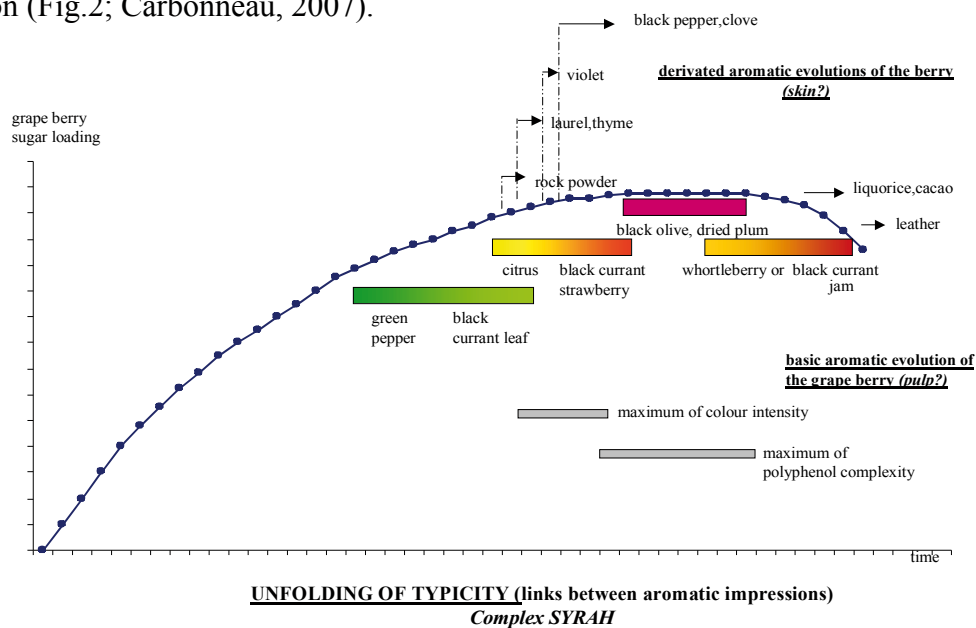


Figure 2. Modelling for Syrah the relationship between dynamics of berry sugar loading and periods of occurrence of specific aromatic characteristics in the wine: the general basic and unfolding trend of fruity-type aromas (coloured segments) and some specific derived aromas.

The concept of Viticultural Terroir Unit (VTU) emerged and was defined as the interaction between the BTU, the variety and the cultivation system (training system or canopy management, and soil management). Understanding and experimenting some training systems and cultivation techniques (irrigation, soil management...), measuring the interactions with climate and soil, the main ecophysiological responses of the plant, and the consequences on wine typicity and quality, allow to understand the particularities of the VTU. Some examples in mediterranean terroirs will be summarized, showing new data on the influence of water regulation on wine typicity and root system (Carbonneau, Ojeda et al., 2006). Thus, canopy management is proved to have a strong influence on wine typicity and quality, demonstrating that cultivation practices are part of the terroir (Carbonneau, 2000, 2004; Carbonneau et al., 2007). The vine grower has to find the optimal choice of cultivation techniques, varieties, to express the terroir as much as possible into original wines, or at the opposite to standardize the terroir effects for other wines.

TERROIR – TERRITORY AND MAN

Key idea: Terroir gathers Viticultural Terroir Units inside a territory and man is the centre.

The VTU must be integrated at the more important level of the territory. At that scale one deals with the general ‘terroir’. Scaling up from the plot to the vineyard and the territory, and facing socio-economical problems, allows to deal with the reality of the problems in Viticulture.

A general methodology was proposed by Cargnello (Carbonneau and Cargnello, 2003) in order to evaluate the adaptation of the cultivation system to all objectives of the company, the environment, the market and the man: the ‘Great Chain’ based on the work of a jury of different experts. In that approach, man has a central position, considering for instance that the wine quality is not only the quality we can analyse through laboratory instruments, even through jury of experts in sensory analysis, but the quality which can be detected and liked by the consumer, which also can be purchased by him.

The sustainability of the environment and the viticulture, the general quality of living, are also to be taken in account. Measuring that is extremely difficult and complex; but at the moment, the “Great Chain” is the only one available methodology which was already tested in some Italian terroirs. In particular, it is critical to define new models of sustainable Viticulture, jointly liable and fair way. In addition to what stated above in the report and in the choice of the “grounds to assign to wine”, GiESCO has provided a decisive contribution to take into account and to connect economic goals as well as socio-environmental targets and existential or ethical objectives through “means”. That is the more general sense we can attribute to the terroir.

CONCLUSIONS

Since 1999 at least, the GiESCO has deeply contributed to the scientific and technological progress of the study of terroirs in Viticulture, as far as the group, starting from canopy management, was progressively widened to interacting fields such as Ecophysiology, Climatology, New Technologies, Cultivation Systems, Wine Quality, Territory and Economics. New developments concern either specific scientific studies (ie. Changing physiological stresses), or integrative pluridisciplinary approaches.

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