PhD THESIS

IDENTIFICATION AND CHARACTERIZATION OF TERROIR TYPES IN THE SYLVANIA DEPRESSION

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SUMMARY

Of the PhD thesis "**Identification and characterization of terroir types in the Silvaniei Depression**" by Ing. Drd. Bartha Istvan under the supervision of Prof. Univ. Dr. Laura Paulette.

Key words: terroir, geomorphology, hydrology, soil, climate, anthropic influence, vineyard, viticultural centre, soil analysis, soil quality, mapping, suitability, favorability, mapping of vineyards, research, pedology, Silvaniei Depression;

In this paper the distinctive features of some vineyards in the Silvaniei Depression were analysed, the influence of the terroir on the taste and quality of the wine, and the particularities of the region. A differentiation was made between the different plantations, comparing the vineyards of Șimleu Silvaniei, Sărmășag, Camăr and Carastelec.

The PhD thesis was structured in several chapters. The first chapter refers to national and international research on the interaction of terroir elements, the second one studies the concept of terroir and the viticultural terroir, the third one includes the general characterization of the Silvaniei Depression and presents the Silvaniei viticultural centres, the following fourth chapter studies the aim and objectives of the research, the fifth one includes the results on pedological and agrochemical mapping in the viticultural centres Șimleu and Carastelec and the last sixth chapter is presented the qualitative evaluation by suitability/quality classes and favourability of the land.

Chapter I Current research. This chapter lists some national and international names that have contributed to the understanding of the notion of terroir, the interaction of terroir elements, the concept of wine terroir and makes comparisons between the contribution of different ecopedological factors and their influence on different rootstocks and varieties. The following names who have contributed to international research are worth mentioning:Pouget R.,Juste C., Salette J., (1980-1996) present the problem of calcareous chlorosis and the chlorotic power of soils.

Branas (1978) presents the relationship between vines and the climate-soil system. The concept of terroir and the influence of geology on grape quality are highlighted by Wooldridge(2003), Saayman (1992), Gladstones and Smart(1994). Bonnardot (2002), Bargmann (2003), Conradie, Carey V.A. (2002), Hancock (1999) also contribute to highlighting that the geology of the territory influences terroir

factors. Jones et al. (2004) conclude that the main factors determining vine production are climate combined with the influences of exposure, slope, aspect and soil. Coipel et al. (2010) state that soil type is a true indicator of grape quality. Van Leeuwen et al. (2004) define terroir as an interactive ecosystem between climate, soil, and wine by considering the influence of three parameters: climate, soil and cultivation technology. Deloire et al. (2003) conclude that the relationship between geology and viticulture are essential and that soil studies are indispensable. We mention some names from our country who have contributed to national research. Răuţă et al, 1975., who carried out research to obtain information to characterize the viticultural soil resources in our country and to establish the main pedological and agrochemical factors that play a priority role in the growth and development of vines. Also in order to characterize in detail the whole set of pedological, agrochemical, relief, sediment, groundwater, soil microclimate, cultivation technology and their delimitation in vineyards, researches were carried out by Oancea et al., 1977; 1979. Also in 1981, they established limitations due to the physical and chemical characteristics of the soils, depending on the suitability of different types of soils for vines. C.Răuţă et al. (1984c) studied the ecological conditions for the occurrence of chlorosis from a pedological point of view. Toti and Ignat (2011) summarize the limiting ecopedological factors (terroir) that determine the architecture of the vine root system. Rotaru et al. (2011) conclude that soils and climatic conditions are the main factors influencing their growth, production and quality. Butulescu(2011) considers that terroir is a set of factors that interact in a particular way, giving the wine its originality.

Chapter II-Terroir. Concept, description and characteristics - covers the concept of terroir and viticultural terroir. Terroir is a term of French origin (terre), derived from popular Latin (terratorium - earth)

.First used by the French. Until the 1920s it was only used for regional products such as cheese, meat and meat products, teas, coffee, cheese, herbs or oils. Only after 1920 did they start using the term in viticulture. Terroir is the multitude of all environmental factors, natural factors, local factors of a given territory that affect a crop, including unique environmental contexts, farming and growing practices specific to a habitat crop, that influence the characteristics of the species grown there. The terroir thus represents the unity of all environmental factors: climate (macro and micro), geomorphology, geology, hydrology, geography incorporating the influences of

temperature, precipitation, sunlight, winds, soil with its characteristics such as physical structure, chemical composition, acidity, minerals, permeability, aeration, soil drainage, soil type, slope inclination, altitude, that affect a crop. The interaction between the soil and these elements of nature cannot be separated, just as the interaction of the elements of nature cannot be separated, as they act together, each influencing the other. Terroir is of particular importance as the differentiating, unique attribute of each vineyard. French winemakers have noticed the differences between wines from different regions, vineyards or even different sections of the same vineyard. Wines produced in this way are impossible to reproduce anywhere else, they are specific products, recognisable by the specific characteristics of their territory of origin. Winemakers have concluded that the concept of terroir should be used to describe the unique aspects of a place that influence and shape wine. Each brand of wine has its own specific characteristics, which depend to a large extent on where the grape variety is grown. The factors that give the wines their own character in addition to the environmental factors are the plant (variety and rootstock), cultivation technology (planting, growing, cultivation method, pruning, irrigation, fertilisation, anti-rot treatments, procedures adopted by the oenologist), harvesting (time, moment, method), processing technology (type of fermentation container, time left on the skins during fermentation, time of yeast used, temperature control, etc.), human creativity, oenological tradition. The aim of studies and research into the concept of terroir has been and continues to be the delimitation of controlled origin territories (AOC) in order to obtain the highest quality grape production.

Chapter III-Location and description of the Silvanie Depression-;The Silvanie Depression is part of the Western Hills. Within these hills four units can be distinguished: Hills and Depressions. Baia Mare, the Silvaniei Hills, the Cris Hills and the Banat Hills. The Silvaniei Hills run between Someș and Barcău.The following seven sub-units can be distinguished:Meseș and Plopiș Hills, Barcău Depression, Crasnei Depression (Șimleu), Zalău Depression, Crasnei Hills (Șimleu), Codrului Hills, Sălajului Depression. The Șimleu (Crasnei) Depression lies between the Meseș ridge and the Plopiș mountains to the south-east and south-west, the Plopiș crystalline spur to the north and the Crasna - Zalău interfluve to the east and north-west. The Crasna and Barcău rivers within the depressions have deepened by more than 100 metres forming seven terrace levels. By the modelling action they divided the relief into two

depressional erosion basins: Crasna on the Crasna river and Plopiș on the Barcău river. The relief is characterized by the asymmetry of the valleys, terraces, narrowing and scalloping of the main interfluves. The area is characterized by an active dynamic of the relief, with processes given by areal and linear erosion, combined in places with landslides (Victor Cormoș et al. 1980).

The studied area is part of the disseminated wine-growing centres of Crișana and Sătmar: Diosig wine-growing centres, Silvaniei wine-growing centres, Mihai valley wine-growing centres, Sein wine-growing centre, Halmeu wine-growing centre. The Silvaniei wine-growing centres are located in the Silvaniei Hills region.

The vineyards of Silvaniei are among the northernmost vineyards in Romania due to its northern latitudinal position between 47005 and 47035„. The plantations of the Măgura Hill. are distinguished by a special soil, from which the vines extract the necessary minerals to give birth to elegant wines, full of finesse and refinement. Silvania winery is the producer of the famous Silvania sparkling wine. It was the first winery in Romania to produce sparkling wine in 1974, using the Champenoise method - fermenting wine in the bottle for over a year at a constant temperature and humidity. The natural fermentation of the wine lasts 2-3 years and the wine is matured slowly using special yeasts. During this time the bottles go through a process of "remuage" (tilting the wine at different angles).

A special feature of the winery are the "hrubele" in Măgura Șimleului, 60 metres under the rock with galleries 3.5 kilometres long, which naturally maintain a constant temperature of 12 degrees Celsius, thanks to a noble mould.

Also located in the Măgura Șimleului massif, the region is home to **Crama Vinum Partium.**The vineyard is the result of replanting with vines of the old plantations on the territory of the Carastelec commune. The owners are from Hungary. The winery built in 2011-2012 was awarded the Excellence in Construction Award in 2015. It is the first new generation winery, which was designed, built and equipped to produce sparkling wines with the traditional method and sparkling wines made with the Asti method, i.e. without the addition of carbon dioxide.The entire process of their vinification takes place in the winery, from pressing the grapes, fermentation in the bottle, stirring, disgorging, to labelling. It is a semi-submerged building, it runs on green energy: heating and cooling are provided by geothermal pumps and energy consumption is mitigated with solar cells.

As we've already talked about the fact that the Silvan Vineyards are the northernmost by location **the Fort Silvan 47.**project represents just that footprint. Fort comes from 'fortareață', meaning the unique fortress-shaped architecture of the winery in Romania. Silvan, from Silvania (the wine-growing area of Podgoria Silvaniei). '47', again represents the geographical location of the winery, along the 47th Parallel, northern latitude, the northernmost extreme of viticulture.The grapes mature and accumulate flavours much more slowly, it is beneficial for the wines, because they are complex and balanced, with high acidity and a pronounced mineral character. The winery built in 2015, all stone and covered with earth has a unique architecture, bringing with it a medieval fortress. The cellar is dug into the hillside in the shape of a letter U, with access at each end. The dimensions are also impressive, each side of the cellar being 25 metres long. And above it is a terrace where wine tastings are held.

Chapter IV- Research material and method-;The aim of the research is to identify and characterize the types of terroir in the Silvanie Depression, in the Silvanie wine-growing centres. The objectives pursued to achieve the proposed goal are: general characterisation of the Silvanie Depression and the Silvanie winegrowing centres;characterisation and classification of soils based on their morphological, physical, chemical, mineralogical, etc. properties; through field and laboratory research;establishment of ecopedological factors influencing vine growth and production based on soil and terrain characteristics in the winegrowing centres of Șimleu and Carastelec; description of how the particularities of the studied region-geomorphology, relief, hydrology, climate, soils, tradition-influence the final product, wine, in the studied winegrowing centres; evaluation of the results on pedological and agrochemical mapping in the winegrowing centres of Șimleu and Carastelec; qualitative assessment of the suitability/quality and favourability classes of the soils in the wine-growing centres of Șimleu and Carastelec; indication of the optimal use of the soils in order to obtain maximum yields; highlighting the nature and intensity of the limiting factors of wine production and the requirements for improvement; forecasting the evolution of soils under the conditions of improvement measures and intensive viticulture development, including highlighting the requirements for measures to prevent the risks of degradation; identifying and mapping soils and land, resulting in soil and land maps; drawing up suitability and suitability maps and maps. Soil research is an essential element in determining the factors influencing vine growth and production. Soil survey and mapping is the soil profile. In the vineyard plots studied the following main profiles were carried out: in Șimleu Silvaniei and Sărmășag 5 main profiles and in Camăr and Carastelec 3 main profiles. Soil investigation in the field is a fundamental operation. The soil is studied in terms of its morphological characteristics and intrinsic properties; soil conditions and pedogenetic factors are also described. Soil mapping requires a thorough knowledge of soil classification, of the typical units of climate, relief, rock and parent material, etc., in order to differentiate soil, land, station,

ecosystem units, as well as soil, relief, rock, etc. parameters, with their subdivision into ranges of significance in agricultural and improvement practice, which are very useful in connection with the interpretation of data for practical purposes. Field observations are followed by laboratory observations to identify pedogenetic horizons. The physical and chemical characteristics of soils are analysed.

Chapter V-Results on pedological and agrochemical mapping in Şimleu and Carastelec wine-growing centres. The town of Şimleu and the communes of Sărmăşag, Camăr and Carastelec are located in the Silvaniei Depression and overlap almost entirely with the area linking the Apuseni Mountains and the Eastern Carpathians, known as the Someşană Plateau. The relief is generally hilly and depressional in character.Three distinct geomorphological units are represented in the Şimleu area: plains, hills and hills, mountainous area. The following mesomorphological forms can be distinguished on the territory of Sărmăşag: hills, intercolumnar valleys, accumulation terraces, meadows. At Carastelec and Camăr we distinguish two geomorphological units, namely hills and intra-hill valleys.

The complex palaeogeographic evolution of the Someş Plateau has meant that the rivers of the study area are not constituted in a unitary network, belonging to three hydrographic basins: Someş, Crasna and Barcău. The commune of Camăr belongs to the Barcău river basin, while the rest of the study area is located in the Crasna river basin, which is the second largest and most important river in the county of Sălaj. The Barcău basin is an open river basin. The Barcău River, the most important tributary of the Criş Repede. The Barcău valley is in the dominant note of the rivers in western Romania, both in terms of the formation of the flow and its regime.

The studied areas have a moderate temperate continental climate, with sub-Mediterranean oceanic influences, belonging to the low hills climate stage. The relief, by its aspect and altitude, creates climatic differentiations, on the one hand between the west and east of the county, and on the other, between the main geomorphological units. From a pedo-geoclimatic point of view, the communes of Carastelec, Sărmăşag and Camăr are part of a moderately cool-humid climate, with moderately hilly relief, having as predominant soil Luvosol albic, reason why it has been classified in the climatic microzone with the symbol 78/13aIIID-BP; , Şimleu Silvaniei falls within a moderately cool-humid climate with a slightly hilly relief, with predominantly Luvosol soil, for which reason it has been classified in the climatic microzone with the symbol 77/9 IIIC-BP.

The soil is an essential component of vine-growing ecosystems, playing a decisive role in supplying the water and mineral elements necessary for plant nutrition and creating the conditions for their absorption, and is in turn the result of the action of pedogenetic factors on various geological materials whose characteristics are reflected in the soil's physical and chemical properties. Soil factors, which refer to the soil with its physical, chemical and biological properties, together with climatic factors, influence the growth and fruiting processes, the quantity and quality of vine production, the longevity of the vineyard, resistance to disease and weathering, etc. The influence of the morphological, physical and agrochemical properties of the different types of soil, in conjunction with the characteristics of the natural environment and the level of cultivation technology, is reflected in the varying levels of

production from one vineyard to another. In addition to the habitus of the vines, the soil influences the quality of the grapes and the wines produced from them. The soil is in a constant state of change, caused by its preparation before planting.

The necessary and compulsory works for the preparation of the land for the planting of vines, the works of land clearing, earthworks modify the physical, chemical, hydrophysical characteristics of the soil, the nature of the soil materials, the morphology of the soil is modified, the horizons are mixed following the land clearing to a depth of 50-60 cm. Depending on the way in which the land is cleared, the soil horizons are altered, in some cases even to the extent of removing the soil from a depth of 50-60 cm and burying the ploughed layer at the depth indicated.

At the **SILVANIA** vineyard, the following soil types have formed within the 38 hectares of vineyards - 8 at the entrance to Şimleu Silvaniei and 30 hectares in Sărmăşag:

At the plantations in Şimleu Silvaniei there is a single soil type with five subtypes: Proxysubscheletic Cambic Arbic Anthrosol, Proxysubscheletic Cambic Arbic Anthrosol, Hyposcheletic Cambic Arbic Anthrosol, Proxysubscheletic Cambic Arbic Anthrosol, Proxysubscheletic Cambic Arbic Anthrosol.Within the plantation plots in Sărmăşag, four soil types were delimited: stagnant Luvosol, typical eroded Luvosol, stagnant argic Faeoziom, stagnant Vertosol.

At the **Fort Silvan 47 vineyard** in the commune of Camăr, a single soil type was formed within the 33.58 ha of land proposed for planting vines for wine production: Faeziom with the subtypes: stagnant argic, stagnant vertic, typical, In the commune of Carastelec, 22.4 ha were planted at the **Vinum Partium vineyard,** where a single soil type was also formed: Antrosol with the subtypes: stagnant pre-aric, cernic aric, pre-aric.

The establishment project was based on an eco-climatic study and a pedological study. Based on the ecoclimatic study, the cropping system, the planting distance and, following the pedological and agrochemical mapping, the soil preparation system, the anti-erosion system and the doses of fertilizers and amendments, as well as the rootstock used, were established. The parceling of the land resulted in 7 vineyard plots in Şimleu, 10 plots in Sărmăşag, 8 plots in Carastelec, and 14 plots in Camăr, each vineyard plot consisting of several subplots. Varieties were planted which fall within the list of eligible varieties, with subsequent additions, varieties with a good production potential of 8-10t/ha, which accumulate more than 200g/l sugars in the must at harvest and from which quality wines, wines with a controlled designation of origin or geographical indication can be obtained. . Grafted vines of noble vine varieties have been planted in the vineyard in the commune of Sărmăşag to produce quality wines: Feteasca Regală, Pinot Noir, Muscat Ottonel, Traminer, Merlot, Riesling Italian, in Şimleu Silvaniei Feteasca Regală, Pinot Noir, Mustoasă de Măderat, in Carastelec Fetească Regală, Riesling Italian, Pinoit Noir, Pinot Gris, and not least in the vineyard of Camăr : Traminer, Muscat Ottonel, Merlot, Feteasca Neagra, and Cadarca. In the area studied, the cultivation technology applied for DOC Crişana is used. The quality and characteristics of the wines produced in the area delimited for the "CRIŞANA" controlled designation of origin are essentially due to the geographical environment, with its natural and human factors.

The **Silvania vineyard** is the producer of the famous sparkling wine in the country and abroad. **SILVANIA** range of wines Premium luxury sparkling wines,

Premium sparkling wines, still wines.**Carastelec winery** is the first investment in Romania designed to produce mainly sparkling and effervescent wines.**CARASSIA** sparkling wine is the pride of the winery, and the brand dedicated to sparkling wines is **FRIZA. VINCA** is the brand dedicated to still wines. Camăr produces no less than eight varieties of wine, four of which are white varieties and four red. There are premium wines with the following ranges: the **Fort Silvan** range is the first range started in 2016, the second range is **Super Premium 47, the third range FS 47.**

Chapter VI-Quality assessment by land suitability/quality and favorability classes. In any pedological study, the restrictions and limits on which the nature and intensity of hydro-amelioration, agropedological or agro-phytotechnical measures to increase the productive capacity of the soil depend, on the one hand, and the efficiency of investment and/or exploitation works, on the other, must be mentioned. In this respect, each category of special soil study will focus on the specific constraints (limitations) of the objective pursued, separating the practical ones that cannot be improved from those that can be improved. Two aspects are differentiated in soil improvement studies: the need for the improvement work and the suitability of the land for the execution of the improvement work. Grouping (classification) of land according to restrictions and corresponding remedial measures, based on the assessment of the intensity of restrictions according to well-defined quantitative criteria. The land classification, the determination of the suitability of the land, complements this classification, grouping, and aims to determine the productive capacity of the land for different uses or crops and under different management-improvement hypotheses, corresponding to the category of the particular soil study. Initial pedological and agrochemical mapping was carried out before planting, after the results and recommendations were obtained, planting was carried out and in the last phase the final mapping was carried out according to the recommendations made. The plantations were compared with each other by quality classes, favorability, suitability and the quality classes were made after the pedo-improvement works with the new enhanced bonitability grades, where it can be seen that the bonitability grades have improved and are presented by the bonitability tables and maps of quality classes, favorability and suitability. To achieve this objective, data from the Office for Pedological and Agrochemical Studies of Sălaj (OSPA Sălaj) and from the companies that produce and vinify wine were used: Podgoria Silvania, Fort Silvan, Vinum Partium.