IMPORTANCE OF THE TERROR VARIABILITY MAP (TVM) IN PRECISION VITICULTURE (PV): CHOICE OF METHODOLOGY FOR SOIL CLASSIFICATION

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Abstract:
Context and purpose of the study – ThePrecision Viticulture (PV) is defined "as a management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, vigour, nutrients, pests, moisture, and yield among others, for optimum profitability, sustainability, and protection of the environment" (OIV, 2018, in process). The elements mentioned in the definition are an important part of the terroir components. The terroir is a tool In Viticulture, it is the analysis and study unit, and the variability of a certain situation can be due to any difference in every element or property of each factor that constitutes it, including the management.The soil and its management are those that bring the most variability to terroir. On the one hand, the soil is the factor of the terroir of shortest wave; it means that it is the factor that has the most horizontal variability (geography, cartography) as well as vertical (typology, classification). Besides, due to its properties, mainly as a production factor, the soil is the factor that can easily be modified by the wine-grower and it can be adapted it his interests by the PV, for example.For this reason, the Terroir Variability Map (TVM) is a necessary management tool in PV and it has to join enough conditions of both cartographic quality (scale, predictivity and precision), and content (characterization, quantification, classification and evaluation).This work is about of the most efficient choice of the soil classification in relationship with best application of TVM related to traceability and technology transfer in the viticulture.
Material and methods – The main characteristics of the most important two soil classifications, exactly the World Reference Base for Soil Resources (FAO system) and the Soil Taxonomy (USDA system) are compared, in relationship with their application in the TVM for its use in the PV.
Results – Three types of TVM related to the terroir zoning studies are defined: **a)** The inventory maps (generalized studies; orders 4, 5 and 6) are useful to identify the possible variability elements of terroir in a wide region with null or slight rate in vineyard occupation and that includes a valuation of these elements. In the inventory TVM, scales of less than 1: 50,000 are used. In 1: 250,000 or lower scales it is possible to use the FAO system but in upper scales it is preferable to use the USDA system in a subgroup level and in which soil phases are included. All the map units of the result are politáxicas. The application of these TVM determines the possible capacity of viticultural use in certain subzones and the exclusion of others; **b)** The management maps (macrozoning studies; orders 2 and 3); are useful to do an identification, characterization and evaluation of the terroir in a certain wine-growing region. In the management TVM scales between 1: 30,000 and 1: 15,000 are used. It is not possible the use of FAO system and it is necessary the use USDA system at the categorical level of families or series, including phases. Politaxic soil map units they are predominant. In these TVM the quality of the different terroir is determined, but the map unit they belong to is not, and because of this they can only be used to management of the wine-growing region (for example, on the DO), and it can't be used for instance to do direct recommendations about the management to the vine-grower about or for the Precision Viticulture; **and c)** In executive maps (microzoning studies; order 1), scales upper 1: 10,000 (preferably higher than 1: 5,000) are used and it is not possible the use of FAO system, and it is necessary to use USDA system at the categorical level of soil series, including very specific phases and related to terroir. All these soil map units are monotaxics. In these TVM it determines the quality of the terroir and the map unit they belong to and so they can be used for management of the wine-growing region, farm or plot and mainly to do direct recommendations to the vine-grower in the PV application.
Keywords: Zoning, terroir, Soil, Precision Viticulture,Terror Variability Map.

1. Introduction.

Importance Of The Terror Variability Map (TVM) In Precision Viticulture (PV): Choice Of Methodology For Soil Classification

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The Context and purpose of the study

The Precision Viticulture (PV) is defined "as a management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, vigour, nutrients, pests, moisture, and yield among others, for optimum profitability, sustainability, and protection of the environment" (OIV, 2018, in process). The elements mentioned in the definition are an important part of the terroir components. The terroir is a tool In Viticulture, it is the analysis and study unit, and the variability of a certain situation can be due to any difference in every element or property of each factor that constitutes it, including the management.

The soil and its management are those that bring the most variability to terroir. On the one hand, the soil is the factor of the terroir of shortest wave; it means that it is the factor that has the most horizontal variability (geography, cartography) as well as vertical (typology, classification). Besides, due to its properties, mainly as a production factor, the soil is the factor that can easily be modified by the wine-grower and it can be adapted it his interests by the PV, for example.

For this reason, the Terroir Variability Map (TVM) is a necessary management tool in PV and it has to join enough conditions of both cartographic quality (scale, predictivity and precision), and content (characterization, quantification, classification and evaluation).

This work is about of the most efficient choice of the soil classification in relationship with best application of TVM related to traceability and technology transfer in the viticulture.

Material and methods

The main characteristics of the most important two soil classifications, exactly the World Reference Base for Soil Resources (FAO system) and the Soil Taxonomy (USDA system) are compared, in relationship with their application in the TVM for its use in the PV (Table).

Soil Taxonomy (USDA, 2014)		FAO-UNESCO (FAO, 2014)		Map scale	Figure
Classes	Soil Units	Classes	Soil Units		
Order	12	-	-	< 1: 10.000.000	-
Suborder	68	Nivel 1	32	< 1: 5.000.000	-
Great group	444	Nivel 2	216	< 1: 1.000.000	-
Subgroup	~2500	Nivel 3 (not available)	-	1.500.000	-
Family (50)	~ 8.000	Not	-	< 1: 250/50.000	2
Series	>23.000 (in US)	Not	-	> 1: 50/25.000	3-8
Fases (soil map)		Fases (soil map)		Whichever, in any class	-

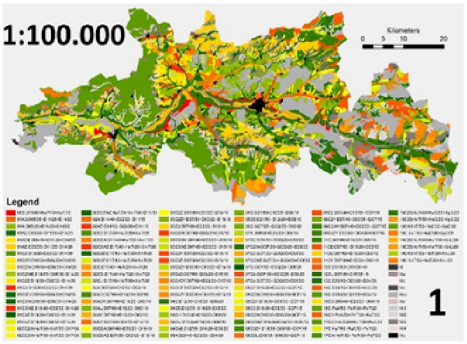
Results

Three types of TVM related to the terroir zoning studies are defined:

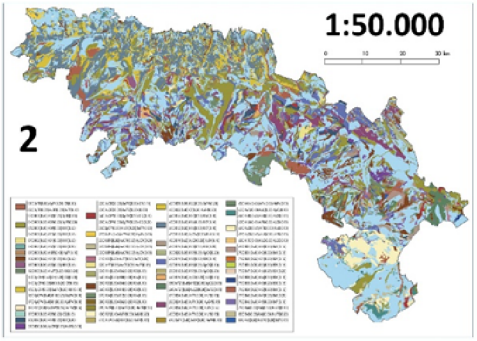
a) The inventory maps (generalized studies; orders 4, 5 and 6) are useful to identify the possible variability elements of terroir in a wide region with null or slight rate in vineyard occupation and that includes a valuation of these elements. In the inventory TVM, scales of less than 1: 50,000 are used (Figures 1 and 2). In 1: 250,000 or lower scales it is possible to use the FAO system but in upper scales it is preferable to use the USDA system in a subgroup level and in which soil phases are included. All the map units of the result are politáxicas. The application of these TVM determines the possible capacity of viticultural use in certain subzones and the exclusion of others;

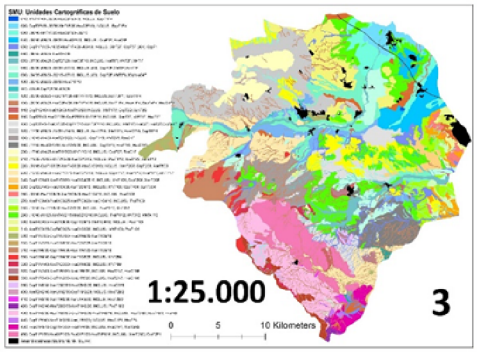
b) The management maps (macrozoning studies; orders 2 and 3); are useful to do an identification, characterization and evaluation of the terroir in a certain wine-growing region. In the management TVM scales between 1: 30,000 and 1: 15,000 are used (Figure 3). It is not possible the use of FAO system and it is necessary the use USDA system at the categorical level of families or series, including phases. Politaxic soil map units they are predominant. In these TVM the quality of the different terroir is determined, but the map unit they belong to is not, and because of this they can only be used to management of the wine-growing region (for example, on the DO), and it can't be used for instance to do direct recommendations about the management to the vine-grower about or for the Precision Viticulture;

c) In executive maps (microzoning studies; order 1), scales upper 1: 10,000 (preferably higher than 1: 5,000) are used (Figures 4, 5, 6 and 7) and it is not possible the use of FAO system, and it is necessary to use USDA system at the categorical level of soil series, including very specific phases and related to terroir. All these soil map units are monotaxics. In these TVM it determines the quality of the terroir and the map unit they belong to and so they can be used for management of the wine-growing region, farm or plot and mainly to do direct recommendations to the vine-grower in the PV application.



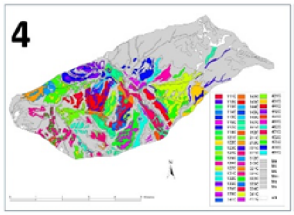
Inventory TVM

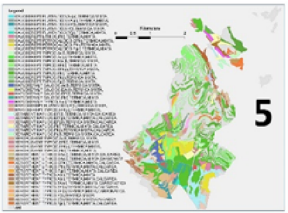


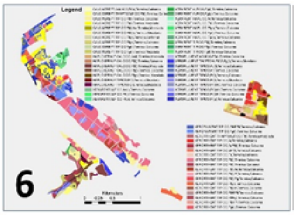


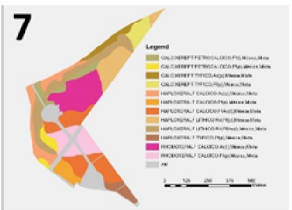
Management TVM (Macrozoning)

Executive TVM (Microzoning)









Escale 1:10.000	Escale 1:7.500	Escale 1:5.000	Escale 1:2.500

GENERAL CONCLUSIONS

Two soil languages are compared: USDA system and the FAO system with examples of TVM at different scales. In the situations presented, it is shown that only Soil Taxonomy meets the requirements for the pedodiversity required for the terroir zoning works applicable to the PV: in the FAO system there are not enough soil types either for the needs of the micro or for macro-zoning.

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References:

FAO. 2014. World Reference Base for Soil Resources. Nº 106 Roma

Gómez-Miguel, V. y V. Sotés 1992-2013: Delimitación de zonas vitícolas en la DO Ribera del Duero, en la DO Ca Rioja, en la DO Rueda, en la D.O. Toro, en la D.O. Bierzo, en la DO Arribes y en la RD Douro. ETSIAAB. Universidad Politécnica de Madrid.

USDA 1992-2014. Keys to Soil Taxonomy. Elevents Edition. Soil Survey Staff. United States Department of Agriculture

USDA. 1993-2017. Soil Survey Manual. Soil Survey Division Staff. Handbook N. 18. United States Department of Agriculture. Washington, DC.