

PRELIMINARY RESEARCH REGARDING THE ELABORATION OF AN ECOLOGICAL EVALUATION SYSTEM FOR THE VITICULTURAL AREAS

CERCETĂRI PRELIMINARE PRIVIND ELABORAREA UNUI SISTEM DE BONITARE ECOLOGICĂ A AREALELOR VITICOLE

IRIMIA L., ROTARU Liliana

University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

Abstract. *In the paper are presented the preliminary results of a study regarding the elaboration of an ecological classification system for viticultural areas. The methodology propose three suitability classes for the most important ecological factors and ecological indicators that reveal the oenoclimatic potential of the vineyard; rating the factors with five, eight or ten points, according to their suitability; conceiving the oenoclimatic suitability of the area by the amount of the rates given to the ecological factors and indicators. According to this classification system, the amount that can be achieved by an area is between 75 and 150 points; the minimum value reveal a low oenoclimatic potential, that allow to obtain white table wines and sparkling wines; the maximum level reveal a high oenoclimatic potential, favourable to obtain red quality wines. The amount of rates calculated for five wine-centres from Moldavia Wine Growing Region is between 90 and 125 points.*

Key words: vineyard, climatic suitability, ecological evaluation, ecological factors, terroir.

Rezumat. *În lucrare sunt prezentate rezultate preliminare ale unui studiu privind elaborarea unui sistem de bonitare ecologică a arealelor viticole. Metodologia propusă constă în stabilirea a trei clase de favorabilitate pentru factorii care condiționează potențialul arealelor viticole; notarea factorilor cu cinci, opt sau zece puncte, diferit în funcție de clasa de favorabilitate; exprimarea potențialului oenoclimatic prin suma notelor de bonitare. Conform acestei metodologii, punctajul pe care-l poate întruni un areal viticol este cuprins între 75 și 150; valoarea minimă relevă potențial oenoclimatic scăzut, suficient pentru producerea vinurilor albe de masă, vinurilor pentru distilate și pentru spumante, iar valoarea maximă potențial ridicat, favorabil pentru producerea vinurilor roșii de calitate. Suma notelor de bonitare calculată pentru cinci centre viticole din Regiunea viticolă a Dealurilor Moldovei este cuprinsă între 90 și 125 puncte.*

Cuvinte cheie: areal viticol, favorabilitate climatică, evaluare ecologică, factori ecologici, terroir.

INTRODUCTION

Ecological evaluation is the analyse of the natural conditions from an area, in order to establish its potential for agriculture. In Romania evaluation of the soils is done according to a system proposed in 1987 by the *National Institute for Pedology and Agro-chemical Research*, from the *Academy of Agricultural and Forestry Sciences*. According to this system, the agronomical potential of the TEO (*Ecological Homogenous Territory*) is assessed in report with the sum of the points conferred for 17 environmental indicators. Because the worth of one rating point is expressed in kg of

yield, the system is a quantitative one. In viticulture the evaluation of an area from a quantitative viewpoint is useful for matching the optimum areas for table grapes and other productive varieties. The zoning of varieties for qualitative wines needs another classification system based on the factors that determines the quality of the yield, respectively the sugar content, anthocyanins, aroma compounds and organic acids.

The qualitative evaluation system is needed to demarcate the “*terroirs*” from PDO (*Protected Designation of Origin*) areas, according to their ecologic features. Knowing the ecological potential of the *terroirs*, and their suitability for grapes growing, would permit an improvement of the precision in conferring the right to produce PDO wines (**CMD** - *Harvested at Full Maturity*; **CT** - *Late Harvest*; **CIB** - *Noble Harvest*). The method can't be used in the areas where at least one ecologic factor is restrictive for the grapevine culture.

MATERIAL AND THE METHOD

For evaluation of the ecological potential of the vine areas we used the climatic indicators, edaphic and topographic factors. The climatic indicators: *the annual average temperature, the average temperature of the hottest month (July), thermic sum, global radiation, solar insolation, the duration of the period with bioactive temperatures and the precipitations from the growing period*. Edaphic factors: *soil texture, soil skeleton and humus content*. Topographic factors: *the slope and the slope direction*.

In addition to these factors we used for evaluation the next synthetic climate indicators: *Branas heliothermic index (IHr), bioclimatic index Constantinescu (Ibcv) and the oenoclimatic aptitude index (IAOe)*.

For every factor and index used in this evaluation, we established three suitability classes: the third class (III) – *less suitable*; the second class (II) – *moderate suitable*; first class (I) – *very suitable*. The suitability classes were determined according to the influence of the factors on the accumulation of the sugar, anthocyanins, aroma compounds and organic acids in the grapes; for the synthetic indexes, the suitability were settled according to their correlation with the quality of the yield. The influence of the factors was quantified by ranking points accorded to the suitability classes: *five* points for the third class; *eight* points for the second class; *ten* points for the first, very suitable class.

The viability of the method was assessed and revealed through the evaluation of the vine growing centres from the north-eastern part of Moldavia: *Murgeni, Huși and Averești - Huși vineyard; Iași - Iași vineyard; Cotnari - Cotnari vineyard*. For this evaluation was considered the main ecological characteristics of the studied vinegrowing centres.

RESULTS AND DISCUSSIONS

1. Establishing the suitability classes for climatic, edaphic and topographic factors. For the thermal factor, the third class characterize the cold areas, capable to produce table wines, sparkling wines and wines for distillation. The second suitability class reveal the possibility to produce the quality wines in the majority of the years; the first class signify the abundance of thermal resources and the possibility to obtain the quality wines every year (tab. 1).

Global radiation (kcal/cm²) and *solar insolation* (hours) determines the sugar, aroma compounds and anthocyanins accumulation (Oslobeanu et al., 1991).

Table 1

Suitability classes and ranking points for the thermic factor

ENVIRONMENTAL FACTOR	Suitability classes/ranking points		
	III / 5	II / 8	I / 10
Average annual temperature (°C)	8.5 - 9.3	9.4 - 10.0	10.1 - 11.0
Hottest month temperature (°C)	18.0 - 19.0	19.1 - 20.9	> 21.0
Thermic sum (>10 °C)	1000 - 1200	1200 - 1400	1400 - 1600

The third suitability class (tab. 2) characterize the cool climates, with few thermic resources, where can be obtained white wines; the second suitability class indicate the existence of heliothermic resources necessary to produce white quality wines and red table wines; the first suitability class define the vineyards specialised in white and red wines, with *protected designation of origin (PDO)*.

Table 2

Suitability classes and ranking points for the solar radiation and insolation

ENVIRONMENTAL FACTOR	Suitability classes/ranking points		
	III/5	II/8	I/10
Global radiation (kcal/cm ² , 01.IV-30.IX)	80 - 83.9	84.0 - 86.9	87.0 - 92
Solar insolation (hours)	1280 - 1450	1451 - 1550	1551 - 1610

Synthetic climate indicators. Their values correlates with sugar, anthocianins and aroma compounds content (Tardea C. and all., 1995). The third suitability class groups the minimum values, characteristics to less favourable areas, that produce white wines; the second class values are characteristic to moderate suitable areas, that generate white quality wines and, in a few years, red wines. The highest ranking - the *first class* - were given to the areas with an abundance of heliothermic resources, where are obtained the most qualitative red wines (tab. 3).

Table 3

Suitability classes and ranking points for the synthetic climate indicators

ENVIRONMENTAL FACTOR	Suitability class/ranking points		
	III/5	II/8	I/10
Heliothermic index Branas (IHr),	1.35 - 1.70	1.71 - 2.20	2.21 - 2.70
Bioclimatic index (Ibcv)	4.0 - 6.0	10.1 - 13.5	6.1 - 10.0
Oenoclimatic aptitude index (IAOe)	3700 - 4300	4301 - 4600	4601 - 5018

The duration of the period with bioactive temperatures (daily average >10°C) indicate the possibility of over maturation and botritization of grapes at the varieties for qualitative wines. The third suitability class permit to obtain white table wines, sparkling wines and wines for distillation. The second suitability class values assure, in the most years, to over mature the grapes and to obtain qualitative wines with *Protected Designation of Origin (PDO)*. The *first class* signify that there are no climate restrictions to cultivate grape varieties for high quality wines (tab. 4).

The precipitations from the growing period influence the growing process, the cluster and berry size. The *third suitability class* includes rainy regions, that produce great yield but low quality; the *second suitability class* include droughty areas, that diminish the acidity and makes the wines fade.

Table 4

Suitability classes and ranking points for the period with bioactive temperatures

ENVIRONMENTAL FACTOR	Suitability class/ranking points		
	III/5	II/8	I/10
<i>The period with bioactive temperatures</i> (days)	160 - 175	176 – 190	> 190

The *first suitability class* include values that reveal moderate annual precipitations, that assure normal intensity in physiologic processes, qualitative yield with equilibrate acidity and large accumulation of sugar, polyphenols and aroma compounds (tab. 5).

Table 5

Suitability classes and ranking points for the precipitations in the growing period

ENVIRONMENTAL FACTOR	Suitability class/ranking points		
	III/5	II/8	I/10
Precipitations (mm, 01.IV - 30.IX)	> 400	< 270	280 - 390

2. Establishing the suitability classes for the edaphic factors. The most important for the suitability of the vineyards are the *soil texture, soil skeleton and the humus content*.

The soil texture influences significantly the size and the quality of the yield. In the *third suitability class* where included the sandy soils, that generate ordinary wines, with lack of acidity and colour. The *second class* integrates the clay soils, fertile, that produce middling wines, with moderate alcohol content and pronounced acidity. In the *first suitability class* enter the loamy soils, that chasten the grow and stimulates the accumulation of the organic compounds in the grapes (tab. 6).

Table 6

Suitability classes and ranking points for the edaphic factors

ENVIRONMENTAL FACTOR	Suitability class/ranking points		
	III/5	II/8	I/10
Soil texture (% clay)	sandy (<15)	clay (>25)	loamy (15-25)
Soil skeleton (%)	< 6	> 20	> 6 - 20
Humus content (%)	> 2.5	< 1.5	1.6 - 2.5

Soil skeleton (particles $\phi > 20$ mm) improve thermic, hydric and aeration parameters of the soil. In the *third class* were included compacted, clay soils, with no skeleton, that generate common wines, lacked of personality; in the *second class* are included the soils with an excessive quantity of skeleton; *the first class* include the soils with a moderate content of limestone skeleton, that confer fineness, minerality and personality to wines.

Humus content. The *third suitability class* comprise the fertile soils, with a large content of humus, that generate table wines; in the *second class* enter the poor soils, with lack of humus, that produce rough, lack of fineness wines. The *first class* include the soil with a moderate content of humus that sustains the quality of the grapes.

3. Establishing the suitability classes for the topographic factors. The most important for the qualitative potential of the vineyards are the slope and the exposure (tab. 7).

Table 7

ENVIRONMENTAL FACTOR	Suitability class/ranking points		
	III/5	II/8	I/10
Slope (%)	< 8	> 15	8 - 15
Exposure	V	E, SV	S, SE

The slope influence the vineyard climate through the altitudinal variation of the temperature, moisture, solar radiation and soil fertility. The *third class* groups the flat terrain, with fertile soils, that generate table wines. The *second class* groups sloping terrains with inclination bigger than 15%, terraced, that diminish wines quality because of the poverty of the poor, anthropized soils. The first suitability class include the moderate slopes; these terrains gather the most favourable conditions to produce the quality wines.

Slope direction. The highest ranking - *the first class* - was given to the south and south – east directions, that benefit the greatest values of global radiation and solar insolation, that support the accumulation of organic compounds in the berries and obtaining the quality wines.

4. Estimation of the ecological potential of the vine areas. Is based on multiannual averages of climatic factors and ecologic indexes, and the data regarding the relief and soil characteristics (Teodorescu St. et al., 1987; Tesu C., Merlescu E., 1982). Every ecological parameters of the vine areas was ranked according to its influence on the grapes and wine quality (tab. 8).

Table 8

Evaluation of the ecological potential of Murgeni vine-growing centre - Husi vineyard

ECOLOGICAL FACTORS		Average	Class	Ranking points	Σ/categ.
Climatic factors	Annual average temperature (°C)	9.8	II	8	90
	Hottest month temperature (°C)	21.7	I	10	
	Thermic sum 1.04-30.09 (>10°C)	1448.0	I	10	
	Global radiation (IV - IX)	88.0	I	10	
	Solar insolation (hours)	1526.0	II	8	
	Heliothermic index (Branas)	1.92	II	8	
	Bioclimatic index	8.8	II	8	
	<i>Oenoclimatic aptitude index</i>	4760.0	I	10	
	<i>Period with temperatures >10°C</i>	205	I	10	
Precipitations (mm)	282.6	II	8		
Edafic factors	Soil texture (% clay)	15 - 25	I	10	20
	Soil skeleton (% rubble)	< 6	III	5	
	Humus content (%)	2.5-2.9	III	5	
Topographic factors	The slope (%)	8 - 15	I	10	15
	Slope direction	SV	II	8	
TOTAL				125	

Maximum synopsis that can be obtain using this evaluation system is 150. The method was used to evaluate the ecologic potential Murgeni, Huși, Averești, Iași and Cotnari vine-growing centres (tab. 9).

Data reveal important differences between vine-growing areas, the most unfavourable is Averești vine-growing centre and the most favourable Murgeni and Cotnari. According to this evaluation system, the climatic suitability of the vineyards in the Moldavia Wine Growing Region decrease from south to north, accompanying the heliothermic resources diminution; ranking sum for climatic suitability decrease from 90 points in Murgeni, at 83 points in Huși, 73 in Copou and 75 ranking points in Cotnari vine-growing centre. The scarcity of heliothermic resources from Cotnari vine-growing centre, is balanced by a greater suitability of the edafic and topographic factors.

Table 9

Evaluation of the ecological potential of Huși, Averești, Iași and Cotnari vine-growing centres

VINE-GROWING CENTRE	Ranking points for:			Total
	Climatic suitability	Edafic suitability	Topografic suitability	
HUȘI	83	20	20	123
AVEREȘTI	59	18	13	90
IAȘI	73	20	18	116
CÔTNARI	75	30	20	125

CONCLUSIONS

1. The ecological classification system is required to evaluate the *terroirs* from PDO areas, according to their suitability for grape-growing and wine production, and to improve the accuracy in conferring the right to produce qualitative wines.

2. The influence of the ecological factors is ranked through suitability classes: *the third class (III)* – less suitable; *the second class (II)* – moderate suitable; *first class (I)* – very suitable. Ranking the suitability classes: *five* points for the third class; *eight* points for the second class; *ten* points for the first, very suitable class. The maximum synopsis that can be achieved by a vine area according to this system is 150 points.

3. The vine growing areas from the north-eastern part of Moldavia achieved the next synopsis: Murgeni vine-growing centre – 125 points; Huși – 123 points; Averești – 90 points; Iași – 116 points; Cotnari – 125 points.

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