THE RELATIONSHIP BETWEEN SOIL TYPE AND DRY EXTRACT CONTENTN IN RED WINES FROM NORTHERN TRANSYLVANIA

BURDEA R.O.[1)*] , Tiberia Ioana POP[2)], Anca Cristina BABEŞ[1)], C.I. BUNEA[1)], Nastasia POP[1)], T.M. GOCAN[1)] , Mirela Gabriela HEIZER[3)]

[1)]University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Horticulture, Mănăştur Street, No. 3-5, 400372, Romania

[2)] University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Faculty of Agriculture, Mănăştur Street, No. 3-5, 400372, Romania

[3)] National Office for Vineyards and Wine Products, 49 Iancului Road Street, 3 Sector, Bucharest, Romania

*Corresponding author: remusburdea@gmail.com

Abstract. The study of dry extract was conducted on Fetească neagră variety, cultivated in five vineyards, in the Northern Region of Transylvania, in a white wines consecrated area, to find favorability for red wines. The research was conducted on protected geographical indications and protected designations of origin in correlation with five soil types on which the black grapevine are cultivated. Were used analitycal results from an official authorized laboratory and samples presented to national evaluating commisions for origin and authenticity certification for the commercialize purpose with protected geographical indication or protected designation of origin. The soil type and the location are not limitative factors for accumulating of high values of dry extract in the grapes destinated for producing red wines. The results were almost similar in the red wines produced in clasical white wines area, with those from a consecrated area for quality red wines.

Keywords: soil, vineyards, dry extract, red wines

INTRODUCTION

The Northern Region of Romania is consecrated for white wines, zoning established taking into account "oeno-climatic aptitude index", because it is correlated with the rainfall regime. Our research was conducted between 45-47 degrees North Latitude, in a temperate-continental climate, on two protected designations of origin (PDO): Crișana, Lechința, and one protected geographical indication (PGI) Dealurile Sătmarului, for comparison with Protected Designation of Origin (PDO) Miniș, all registered in the electronic register eAmbrosia, for european and international protection, since 2011.

In PDO Crișana the influence of the Central European climate seems to be less favorable to the development of any wine grape varieties. However, here are produced remarkable white wines and quite interesting red ones. The characteristic natural factor is the Crişul Repede area, bordered to the north by the Şes Mountain, the mild hills downward to the plain and the influence of the Central European climate, specific climate of the low hills (below 500 m) with average of annual temperatures 8-10°C,

rich rainfall (a sum between 700-1.000 mm/ year), which determines a certain decrease of the temperature resources and a supplementation of the pluviometric regime. Here are situated the Silvania's dissipated viticultural centers, with some important vineyards: Carastelec, Camăr, Nușfalău. According to the previous 1990's scientific literature (the main documentary source for researchers was former Soviet Union), the pedo-climatic conditions did not recommended Silvania's vineyard for the red varieties.

Plantations created in the last 10-12 years have begun to disprove these theories. The main soils here are albic endostagnic luvisols WRB2014. The hilly area of Maramureş, determines a certain decrease of the temperature resources and a supplementation of the pluviometric regime but there, in the mild winters, the well sunny vineyards are taking shelter from cold winds and currents. The remarkable decrease of the level of daily mean air temperatures, by 3-4°C, in September, leads to the preservation in grapes that compounds which are sensitive at higher temperatures, like flavors and acids. There are more sunny slopes in the area with an average temperature of over 10.0°C (maybe even higher on Răteşti) and the mean temperatures in July rise to 20.0°C, redistribution of the air currents on the slopes gives the vineyards the advantage of some higher temperatures. In this area, were recorded precipitation with a multiannual average of 650-700 mm. The ripening of the grapes is favorized by the number of sunny days totaling 2.000 hours/year, but also by the wind regime with predominant North-West spring winds. The soils from Răteşti have clay deposits, together with the yellowish brown or reddish ones with pebbles and sands in the more eroded sectors, but the main soils here are Haplic luvisols WRB2014.

On the tops of the hills under the western part of the Oaş Mountains, are siting the northernmost vineyards on the territory of Transylvania, Halmeu Vii, with brown-podzolite soil, offering favorable pedoclimatic conditions, with long autumns and very few rainy days. The characteristic type of soil in Halmeu Vii is brown podzolic on eruptive gravels, lithosols WRB 2014 and the wines are of very particular good quality. The number of frost-free days is 213 days, the average active diurnal temperatures (18.7°C), the length of the vegetation period (175) and the number of days with maximum temperatures (> 30°C), as well as the winters with extreme values make that this area to imprints a certain finesse in wines. (3) The oeno-climatic aptitude (thermoheliohydric index) is 4,287, especially favorable to white wines, but reality and practice proving that the red wines are welcomed too, because the Huglin index (4) is still in the limits with K parameter under 1,06. The thermal component ensures a good evolution of the sugar content and acidity in grapes.

The vineyard "Lechința" is located in the hilly region of Someşul Mare and Mureş in the northeast of the Transylvanian Plateau, located on either side of the parallel of 47° north latitude, between 46°40'; (Hodoşa) and 47°14'; (Dumitra). The relief is exclusively hilly and these hills generally have altitudes between 300-500 m and moderately or strongly inclined slopes (5°-25°C), with a high grade of plantations dispersion.

The soils for viticultural use in Lechința vineyards presents a great variety of soil types and subtypes. The dominant soil types are amphicalcaric fluvisols WRB2014, podzolite brown clayey and eumezobasic brown soils. On the steep slopes can be find the regosols, and on the terraces resulting from the dislocation of large

quantities of soil, are being find the anthropic soils, aric type. On these soils, due to the high content of active calcium and low values of easily assimilable iron, frequently occurs the chlorosis phenomenon.

The aim of this study is to change the consumers perception and to show to viticultors and oenologists some concrete results, to prove that in Romania, in nowadays climate changes conditions, there is not appropriate to have areas delimited only for white wines, or only for red ones.

MATERIAL AND METHODS

Experience was established based on 15 specific red wines, 2019 vintage, in Evaluating Commissions for giving the legal right to trade wines from Northern Transylvanian vineyards, under the name of one Protected Geographical Indication or Protected Designation of Origin.

The wines were selected by some specifically criteria: grapewine variety Fetească neagră, on rootstock Kobber 5 BB, grafted and provided by Vivai Cooperativi Rauschedo Italy, planted in autuumn of 2010, thru the vineyards reconversion using european funds, at 2,2 m between rows and 1 m between vine plants on the row, at density of 4.545 vine plants per hectare. The harvest was made in October, fully rippen grapes at technological maturity, when they accumulated almost 240 g/l sugar.

The parameter dry extract was chosen for the native romanian variety, Fetească neagră, because this characteristic is taking into account in appreciating the body of wine in tasting sessions for the certification proceeding.

Were selected 15 dry red wines, lotized of 5.000 L each one, analized physico-chemical in National Laboratory of Quality Control of Wines from Blaj, Romania and sensorial examinated in 9 official meetings of National Office for Vineyards and Wine Products, by minimum 5 experts per meeting.

Wines were produced in 2019, in five locations: Lechința (Bistrița-Năsăud), in PDO Lechința, Rătești (Satu Mare), in PGI Dealurile Sătmarului, Camăr (Sălaj), in PDO Crișana and Halmeu Vii (Satu Mare), in PGI Dealurile Sătmarului, because in all the specific literature is mentioned that these areas are dedicated exclusively for white wines production, and were compared with a witness from a consecrated region for quality red wines, Miniș (Arad), in PDO Miniș.

The total dry extract is calculated indirectly from the specific gravity of the must and, for wine, from the specific gravity of the alcohol-free wine. This dry extract is expressed in terms of the quantity of sucrose which, when dissolved in water and made up to a volume of one liter, gives a solution of the same gravity as the must or the alcohol-free wine. (5) The total dry extract is reported in g/L to one decimal place.

Soils were identified according to World Reference Base for Soil Resources, 2014 edition, in codification usually wrtiten as WRB2014 (1).

Was performed one-way ANOVA test, on the IBM platform, for five vineyards locations and five types of soil, classified in the World Reference Base for Soil Resources (WRB2014) as follows: eutric cambisols WRB2014 in Miniș, amphicalcaric fluvisols WRB2014 in Lechința, haplic luvisols WRB2014 in Rătești, albic endostagnic luvisols WRB2014 in Camăr and lithosols WRB2014 in Halmeu Vii.

RESULTS AND DISCUSSION

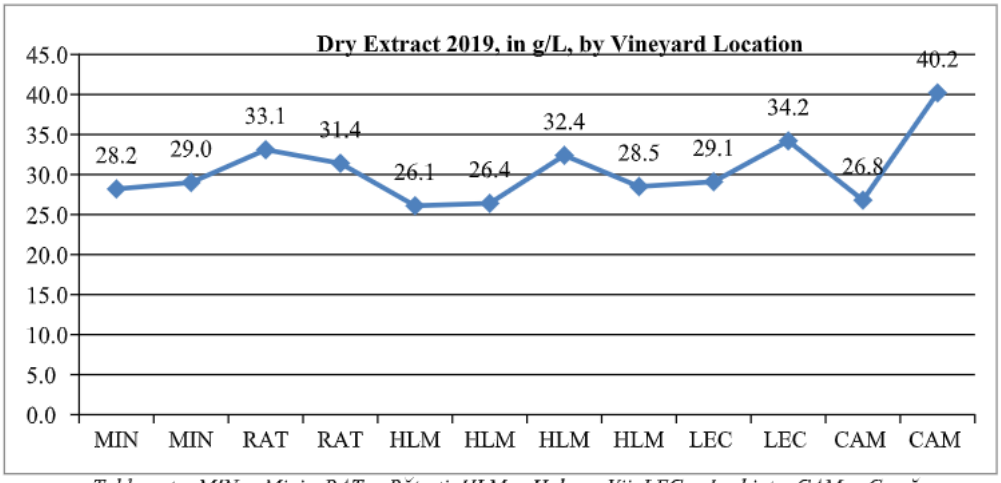

Table note: MIN = Miniș, RAT = Răteşti, HLM = Halmeu Vii, LEC = Lechința, CAM = Camăr

Fig. 1. Dry extract content observations in 2019 wines from studied locations

The main results of this research is that the soil type and the location are not limitative factors for accumulating of high values of dry extract in the grapes destinated for producing red wines. The results were almost similar in the red wines produced in clasical white wines area, with those from a consecrated area for quality red wines, PDO Miniș.

In the same area was found more than one type of soil and the wines sampling followed the same pattern.

The Figure no. 1 above shows that in any other vineyard than the witness from PDO Miniș, the red wines acquired more dry extract in their complex composition, even if that those areas were dedicated for white wines, which naturally accumulate a small amount of dry extract.

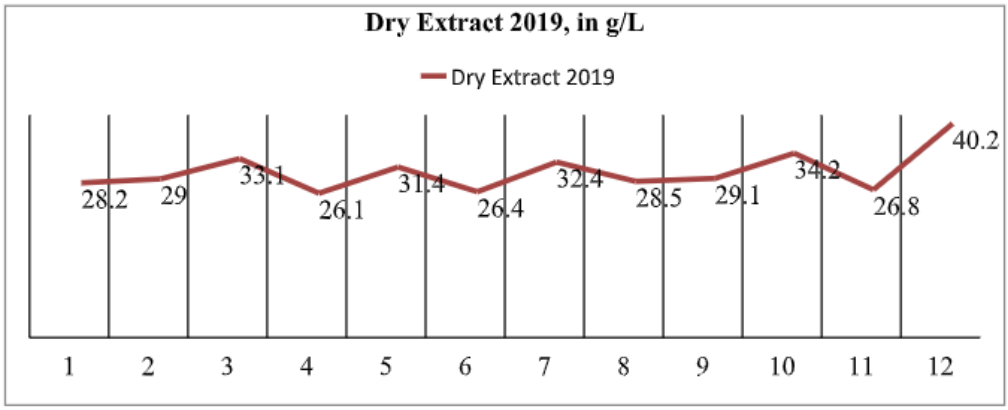

Fig. 2. Dry extract content observations in 2019 wines on studied soil types

As it could be seen in Figure no. 2, all the dry extract values are around the witness, and there are no extracts lower than in the witness eutric cambisols in Miniș.

Descriptives

Dry Extract 2019

Table 1

Dry extract Descriptive overall statistic test by soil types

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
eutric cambisols	2	28,600	,5657	,4000	23,518	33,682	28,2	29,0
haplic luvisols	4	29,250	3,5351	1,7675	23,625	34,875	26,1	33,1
albic endostagnic luvisols	2	33,500	9,4752	6,7000	-51,632	118,632	26,8	40,2
amphicalcaric fluvisols	2	31,650	3,6062	2,5500	-,751	64,051	29,1	34,2
lithosols	2	30,285	2,9486	2,0850	3,793	56,777	28,2	32,4
Total	12	30,423	4,0835	1,1788	27,828	33,017	26,1	40,2

As is shown in the Table no. 1, the standard deviation (Std.deviation) is major for the vineyards set on albic endostagnic luvisols (in Camăr). This is higher than every other, forsure because in this area, 2019 was a lack of preciptations year, and there didn't occured any water stagnations.

Tests of Homogeneity of Variances

Table 2

Dry extract statistics descriptive homogeneity by soil types

		Levene Statistic	df1	df2	Sig.
Dry Extract 2019	Based on Mean	50,452	4	7	,000
	Based on Median	37,966	4	7	,000
	Based on Median and with adjusted df	37,966	4	3,000	,007
	Based on trimmed mean	50,248	4	7	,000

The homogenity of variances define the characteristic of dry extract values on every soil type. This homogenity was disturbed with a small difference based only on the Median, with adjusted of degrees of freedom, because of the extreme values registered of minimum 26,1 g/l on haplic luvisols in Rătești and maximum 40,2 g/l for albic endostagnic luvisols in Camăr (Tabel 3). In all the other cases level of significance is 000, which means that there are very close values of dry extract in every tested wine.

ANOVA
Dry Extract 2019

Table 3.

Dry extract analysis of variance by soil types

		Levene Statistic	df1	df2	Sig.
Dry Extract 2019	Based on Mean	50,452	4	7	,000
	Based on Median	37,966	4	7	,000
	Based on Median and with adjusted df	37,966	4	3,000	,007
	Based on trimmed mean	50,248	4	7	,000

In the Table no. 1 is obvious that the significance value is close to the 1, which means that majority of dry extract values are positive and there are no significant differences between the soil types, no matter where these are situated. This is one important result, proving in the right choosing to plant black grape varieties in the areas where they never were cultivated before the 2007 year (the year of the first vineyard reconversion planted in Romania with European Union funds).

ANOVA Effect Sizes[a,b]

Table 4

Dry extract ANOVA effect sizes on soil types

		Point Estimate	95% Confidence Interval Lower	Upper
Dry Extract 2019	Eta-squared	,186	,000	,333
	Epsilon-squared	-,279	-,571	-,048
	Omega-squared Fixed-effect	-,250	-,500	-,043
	Omega-squared Random-effect	-,053	-,091	-,011

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.
b. Negative but less biased estimates are retained, not rounded to zero.

The upper and lower limits of the confidence interval are not symmetrical to the estimated witness point. That is normal, because the level of dry extract depends on large number of different factors, the soil type being just one of them (Tabel 4).

Multiple Comparisons (Post Hoc Tests)

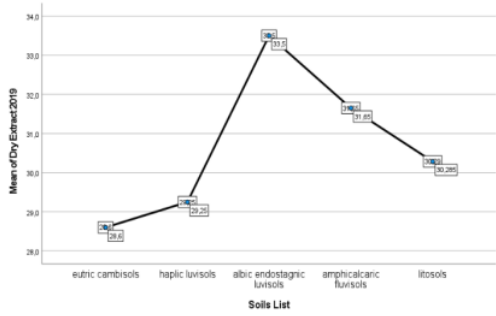

Fig. 3. Dry extract mean plots by soil types

Table 5

Dry extract Post Hoc Tests on soil types

(I) Soils List	(J) Soils List	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
eutric cambisols	haplic luvisols	-,6500	1,8122	,995	-9,677	8,377
	albic endostagnic luvisols	-4,9000	6,7119	,924	-177,719	167,919
	amphicalcaric fluvisols	-3,0500	2,5812	,784	-63,071	56,971
	lithosols	-1,6850	2,1230	,907	-48,407	45,037
haplic luvisols	eutric cambisols	,6500	1,8122	,995	-8,377	9,677
	albic endostagnic luvisols	-4,2500	6,9292	,954	-136,572	128,072
	amphicalcaric fluvisols	-2,4000	3,1027	,919	-25,804	21,004
	lithosols	-1,0350	2,7334	,993	-17,695	15,625
albic endostagnic luvisols	eutric cambisols	4,9000	6,7119	,924	-167,919	177,719
	haplic luvisols	4,2500	6,9292	,954	-128,072	136,572
	amphicalcaric fluvisols	1,8500	7,1689	,998	-105,701	109,401
	lithosols	3,2150	7,0169	,982	-119,037	125,467
amphicalcaric fluvisols	eutric cambisols	3,0500	2,5812	,784	-56,971	63,071
	haplic luvisols	2,4000	3,1027	,919	-21,004	25,804
	albic endostagnic luvisols	-1,8500	7,1689	,998	-109,401	105,701
	lithosols	1,3650	3,2939	,989	-25,159	27,889
lithosols	eutric cambisols	1,6850	2,1230	,907	-45,037	48,407
	haplic luvisols	1,0350	2,7334	,993	-15,625	17,695
	albic endostagnic luvisols	-3,2150	7,0169	,982	-125,467	119,037
	amphicalcaric fluvisols	-1,3650	3,2939	,989	-27,889	25,159

The Post Hoc Test reveals that on every point, the significance is close to 1, with some low values to the amphicalcaric fluvisols, in Lechința, compared with the witness with eutric cambisols, in Miniș, which means that these soils are sustained too by another bio-factors for nutrients accumulation in grape berries (Table 5).

Descriptives by the vineyard location

Dry Extract 2019

Table 6

Dry extract Descriptive overall statistic test by vineyard location

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	Upper Bound	Minimum	Maximum
Miniş	2	28,600	,5657	,4000	23,518	33,682	28,2	29,0
Lechinţa	2	31,650	3,6062	2,5500	-,751	64,051	29,1	34,2
Răteşti	2	32,250	1,2021	,8500	21,450	43,050	31,4	33,1
Camăr	2	33,500	9,4752	6,7000	-51,632	118,632	26,8	40,2
Halmeu Vii	4	28,343	2,8895	1,4448	23,745	32,940	26,1	32,4
Total	12	30,448	4,0696	1,1748	27,862	33,033	26,1	40,2

As it is seen in the Figure no. 3, on all other types of soil, the black grape varieties can extract more nutrients for transforming them in future dry extract from red wines, than from witness soil. The witness dry extract, on eutric cambisols has the lower value, even if it is located in a consecrated area for producing red quality wines, wich means that must taking into account other factors, as the yield level - quantity, not only the quality level.

Contrary, looking at vineyard locations, because there are more than one soil type in the same viticultural area, the results are different too (Figure 2 and Table 7).

Because of more than one type of soil in the same location, the homogenity based on Median and with adjusted degrees of freedom is higher than in the test based on soil types (Table 8).

Tests of Homogeneity of Variances

Table 7

Dry extract statistics descriptive homogeneity by locations

		Levene Statistic	df1	df2	Sig.
Dry Extract 2019	Based on Mean	11,657	4	7	,003
	Based on Median	8,192	4	7	,009
	Based on Median and with adjusted df	8,192	4	3,000	,058
	Based on trimmed mean	11,596	4	7	,003

Concerning the locations, the significance is lower, because the same type of soil is find in more than one location. Entire North and Vest Transylvania is characterized by these soil types. It looks like the Panonic Sea crushed its sediments to the line of Occidental Carpatian Mountains, giving birth to a large variety of soils, spread on such large area (Table 9).

Table 8

Dry extract analysis of variance by locations

ANOVA

Dry Extract 2019

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	52,576	4	13,144	,710	,610
Within Groups	129,598	7	18,514		
Total	182,174	11			

The upper and lower limits of the confidence interval are not symmetrical to the estimated witness point, which means that as like the soils, locations give non homogenous values, but very close each other (Tabel 10).

The Post Hoc analysis is suposed to give controversal results, and the temptation to search only for the positive answers exist in a lot of researches, so it wasn't made for the locations too.

Dry extract represented on vineyards shows that in all the mentioned locations the values are quite close and more than that, the values found in Halmeu Vii are almost similar to those found on witness Miniș (Figure 4).

ANOVA Effect Sizes [a,b]

Table 8

Dry extract ANOVA effect sizes on location

			95% Confidence Interval	
		Point Estimate	Lower	Upper
Dry Extract 2019	Eta-squared	,289	,000	,455
	Epsilon-squared	-,118	-,571	,143
	Omega-squared Fixed-effect	-,107	-,500	,133
	Omega-squared Random-effect	-,025	-,091	,037

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.
b. Negative but less biased estimates are retained, not rounded to zero.

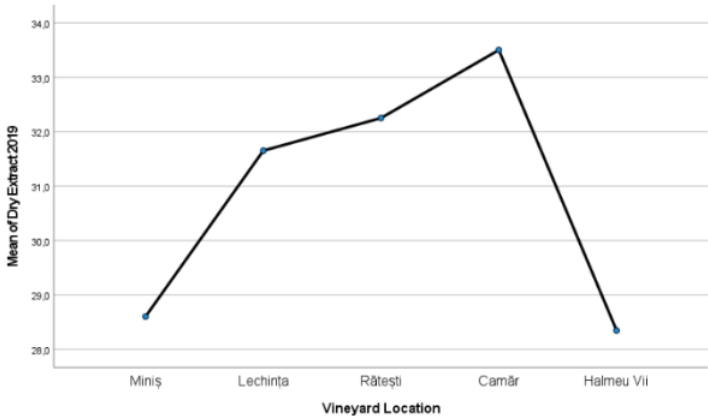

Fig. 4. Dry extract mean plots by locations

CONCLUSIONS

In the current climate change and their increasingly visible effects on crops intended for human consumption, it is no longer possible to restrict the cultivation of vines between the parallels 30° and 50° North latitude. More than this there are enclaves, even close to 50° North, where certain factors, especially the type of soil and the southern exposure on the slopes, considerably decrease the limiting level given by the geo-position.

A type of soil favorable to the cultivation of vines, associated with favorable insolation conditions, benefiting in background of canopy management ends with significant accumulations of dry matter in grapes and implicitly in full-bodied wines, which are suitable for aging and classifying to premium level of quality.

The North and North West area of Transylvania becomes an important area in the production of quality red wines, even if the existing literature at this moment mentions, based on exclusively climatic research, that only white wines can be produced here.

This research is the first concrete step in demonstrating the favorability of the vineyards in Lechința, Rătești, Camăr, Halmeu Vii and others around them, for the production of quality red wines, at least from the local romanian variety Fetească neagră.

REFERENCES

1. Toti, M., Vlad, V., Dumitru, M., Calciu, Irina (2017), Solul – element de bază al conceptului de ”Terroir”. Ed. Terra Nostra, Iași, pg. 217-349

2. http://www.onvpv.ro/ro/content/caiete-de-sarcini-pentru-obtinerea-vinurilor-cu-denumire-de-origine-controlata-doc-0, accessed 20.08.11

3. http://www.onvpv.ro/ro/content/indicatii-geografice, accessed 20.08.11

4. https://en.wikipedia.org/wiki/Huglin_index, accessed 20.08.11

5. http://www.oiv.int/public/medias/2471/oiv-ma-as2-03b.pdf, accessed 20.08.16