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Characterization of some local grape varieties for wine and their suitability for obtaining high quality wine products

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Abstract Research has been carried out in Buziaş vineyards, a grape-growing region where, over time, a number of local grape cultivars and biotypes have been identified, both for table and for wine or mixed.
The local/autochthonous cultivars from the trial field were identified in 2008 and were observed during three years through a PhD thesis finalized in 2011. The purpose of the research carried out during 2017-2018, was to observe some local wine grape cultivars from those identified in 2008, to establish if their qualities were kept over time and their suitability for obtaining wine products of high quality, considering that the area is suitable for many grape varieties, recognized by the emergence on the market of high quality and competitive wines.

Key words

local varieties, bud break, buds viability, blossom, veraison, harvest

Local cultivars are an important genetic resource for the future grapevine development and preservation to new climatic conditions and new types of wine on the market [10, 15].
The hardness of vine to cold injury is different depending on the variety, the degree of tissues maturation, the stage when frost occurs and set, the exposure of vines to cold injury, the type and duration of frost, the impact and destruction potential of cold event, etc. [11; 14]. The resistance of the different organs of the vine is also different [17]. Buds are temporary organs, which under favourable environmental conditions start growing and give rise to the other plant parts [2].
Winter buds can survive to temperatures around -18 ± 3 °C, depending on the variety [4]. The degree of frost damage on buds is influenced by crop technology, yield, climatic conditions, physiological condition of the vine, but also by the genotype of varieties [13].
The viability of the buds is very important because, depending on the rate of bud losses, can be determined the vine bud load after pruning, for next yield [16]. If the percentage of unfertile buds is higher than 10%, a compensated bud load is estimated [3].
Depending on the biological characteristics of the variety, the vegetation condition of the previous growing season, the amounts of sunshine and rainfall resources, the growing area, the soil fertility and applied agrotechnics [8], bud loads can be increased or decreased on vine [7].
Grape varieties for wine generally have a better resistance to low winter temperatures compared to table varieties [19]. The leaf area parameter measures the photosynthetic potential of grape variety with direct influence on productivity [9]. Annual increase of fruiting wood is an important indicator showing the adaptability of variety to the climatic conditions from the growing area and the resistance of the variety to low winter temperatures [6].

Material and Method

Research has focused on the evolution of the three local varieties of red grapes (Cabasmă neagră, Negru compact, Vulpea), during the vegetation in two consecutive growing seasons (2017-2018**).** Phenological observations were realised during each vegetation stage. Buds viability, length of one year old canes, quality parameters (sugar, acidity, maturation index, alcohol potential). Determination of buds viability was performed in the last decade of February, and first decade of March, in each growing-season after last frost and before pruning.
The purpose was to establish the percentage of viable and dead buds, their position on the canes and to estimate the bud load and the length of the fertile shoots. The bud fruitfulness of local grape varieties for red wines, like other parameters, was compared with those of Cabernet Sauvignon variety which is well-known for special agrobiological and technological traits. In recent years, climatic conditions had quite high variability, influencing the grapevines during winter dormancy.
The total length of the one year old and matured wood was determined towards the end of the growing season, which naturally occurs with the veraison stage. Therefore, the total length of the shoots on each vine was measured, and to find out the length of the matured wood, was made the difference between the total maturated wood and immature wood length. This

operation was performed in autumn after the fall of the first hoar-frost, to easily identify the mature and immature wood. By calculating the ratio between the mature and immature wood length, the percentage of matured wood length was found.
Qualitative indices suppose the determination of grape sugar at harvest, which was done using a digital handheld refractometer; determination of total acidity by titrimetry method; calculation of the maturation index, as well as the calculation of the alcohol potential. Grape samples were collected from the harvested grapes, for analyzing both their physicochemical and organoleptic properties.
Statistical analysis was performed by using Statistica 8 (version 2008) (StatSoft, Inc., Tulsa, OK, USA). The probability level used was $p \leq 0.05$.

Results and Discussions

The development of the main phenological stages of local grape varieties for red wines during trial is presented in Tables 1 and 2. In 2017, the earliest budburst began on the 23rd of April at local varieties Negru compact and Vulpea, and the stage timing ranged between 9 to 10 days.
First blossom started at the local Cabasmă neagră in 31.V and lasted about a week. The same behaviour was observed in the local Vulpea variety, but also in the Cabernet Sauvignon which is the control variety.
The earliest veraison started at the local Vulpea variety and generally ranged from 7 to 8 days in the other varieties. The grape maturation ranged between 19-20 days; the latest maturated variety was Negru compact.

Table 1

The development of the main phenophases during the growing season in the local grape varieties for red wines in 2017

No.	Variety/Biotype	Budburst	Blossom	Veraison	Fruit Maturity/Harvest
1	Cabasmă neagră	24.IV-29.IV	31.V-08.VI	1.VIII-8.VIII	10.IX-30.IX
2	Negru compact	23.IV-02.V	2.VI-7.VI	1.VIII-7.VIII	11.IX-01.X
3	Vulpea	23.IV-03.V	4.VI-11.VI	31.VII-09.VIII	08.IX-27.IX
	Cabernet Sauvignon (C)	26.IV-03.V	6.VI-10.VI	7.VIII-15.VIII	14.IX-13.X

In 2018, the budburst stage in the local grape varieties for the production of red wines started with a few days (3-6 days) before the Cabernet Sauvignon variety and lasted about 10 to 11 days for each variety.
Blossom began in the early days of June for all varieties and ranged among 5-6 days. Veraison began at the end of July - early August, and the grapes reached full maturity in September (September 7-28), about 10-12 days earlier than the control variety Cabernet Sauvignon.

Table 2

The development of the main phenophases during the growing season in the local grape varieties for red wines in 2018

No.	Variety/Biotype	Budburst	Blossom	Veraison	Fruit Maturity/Harvest
1	Cabasmă neagră	16.IV-26.IV	1.VI-6.VI	31.VII-6.VIII	07.IX-28.IX
2	Negru compact de Silagiu	15.IV-27.IV	1.VI-5.VI	30.VII-5.VIII	08.IX-27.IX
3	Vulpea	18.IV-27.IV	2.VI-8.VI	29.VII-8.VIII	06.IX-28.IX
4	Cabernet Sauvignon (C)	21.IV-30.IV	3.VI-9.VI	2.VIII-9.VIII	11.IX-10.X

The variability of the phenological phases is influenced by climatic conditions but also by the region or cultivar/variety [12]. Bud break, bleeding, shoot growth and fruit set are influenced by the soil moisture in the growing season [5].
In Molinara red grape local variety from Conegliano region Italy, budburst stage range between 1.IV – 2.V, bloom among 21.V – 24.VI, veraison from 20.VII to 17.IX and harvest between 15.IX – 25.X. [21].
Andreini et al. 2009 [1] studied the bud development and reported the bud break for Vermentino, Durella Gentile, Aleatico, Nera 1 Pi, Sangiovese and Ciliegiolo cultivars in the first and second decade of April; for Cabernet Sauvignon bud break time was the second and third decade of April.
Values for the buds fertility, in 2017, were similar to all varieties, around 84-85% fertile buds, but lower values compared with the control variety (Table 3).

Table 3

The buds viability of local red wine varieties and biotypes in 2017

Variety/Biotype	No. of buds	No. of fertile buds	Fertile buds (%)	Unfertile buds	Unfertile buds (%)	Viable buds/ difference compared with the control (%)	Significance
Cabasmă neagră	177	150	84.74	27	15.26	-6.27	0
Negru compact	165	140	84.84	25	15.16	-6.17	0
Vulpea	168	143	85.11	25	14.89	-5.90	0
Cabernet Sauvignon (Control)	178	162	91.01	16	8.99	-	-

DL 5% = 5.6; DL 1% = 9.14; DL 0.1% = 15.21.

However, even the buds fertility of the local varieties was in optimum limits, there were significant negative differences compared to the Cabernet Sauvignon, which had 91.01% fertile buds.

In the winter 2017-2018, lower temperatures influenced the percentage of viable buds in red grape varieties (Table 4).

Table 4

The buds viability of local red wine varieties and biotypes in 2018

Variety/Biotype	No. of buds	No. of fertile buds	Fertile buds (%)	Unfertile buds	Unfertile buds (%)	Viable buds/ difference compared with the control (%)	Significance
Cabasmă neagră	172	144	83.72	28	16.28	-5.72	0
Negru compact	164	135	82.31	29	17.69	-7.13	0
Vulpea	163	138	84.66	25	15.34	-4.78	-
Cabernet Sauvignon (C)	180	161	89.44	19	10.56	-	-

DL 5% = 4.97 DL 1% = 8.23 DL 0.1 % = 13.22

In 2018, the number of fertile buds was different; all varieties registering lower values compared with the control. The lowest values (82.31%) recorded the Negru compact variety. Cabasmă neagră variety recorded 83.72% and Vulpea variety 84.66% fertile buds. Significantly negative differences compared to the control variety recorded local varieties: Negru compact (-7.13%) and Cabasmă neagră (-5.72%).

In Table 5, are presented the average values for the growing season from the trial concerning the buds viability in local wine grape varieties.

Table 5

The buds viability of local red wine varieties and biotypes in 2017-2018

Variety/Biotype	Buds fertility (%)			Fertile buds/ Difference compared with the control (%)	Significance
	2017	2018	Average 2017-2018		
Cabasmă neagră	84.74	83.72	84.23	-5.99	0
Negru compact	84.84	82.31	83.57	-6.65	0
Vulpea	85.11	84.66	84.88	-5.34	-
Cabernet Sauvignon (C)	91.01	89.44	90.22	-	-

DL 5% = 5.76; DL 1% = 9.21; DL 0.1% = 15.78

Regarding the average percentage of viable buds, all varieties recorded average percentages of the fertile buds, lower than control variety Cabernet Sauvignon which had an average of 90.22% fertile buds. Negru compact and Cabasmă neagră varieties recorded significantly negative differences compared to the control variety.

However, both local varieties for red wines have also recorded high average buds viability on the entire trial, which allowed normal pruning.

After three growing season of research, from total 12.3 – 14.4 buds found by Reščič et al. 2015 [18] in Blauer Portugieser local variety from Radovica winegrowing area (South-Eastern Slovenia), around 0.7 – 1.5 were unfertile and between 11.1 – 13.5 were fertile.

Table 6

Total and matured annual growths of local varieties and biotypes for red wine in 2017

Variety/Biotype	Total ripen wood/ vine (m)	Ripen wood /vine (m)	Ripen wood/ vine (%)	Ripen wood/ vine compared to the control (%)	Significance
Cabasmă neagră	16.04	13.88	86.53	-1.38	-
Negru compact	15.38	13.02	84.65	-3.26	0
Vulpea	14.28	12.14	85.01	-2.90	-
Cabernet Sauvignon (C)	16.39	14.41	87.91		-

DL 5% = 3.11; DL 1% = 5.32; DL 0.1% = 8.84

In 2017, total length of ripened wood on the vine increases was 16.04 m in the Cabasmă neagră, 15.38 m in the Vulpea variety and 14.28 m in the Negru compact variety. The values of the ripened wood /vine were 13.88 m in the Cabasmă neagră variety, 13.02 m in the Negru Compact variety and 12.14 m in the Vulpea variety.

Analyzing the percentage of ripened wood growths on vine, all local varieties recorded lower values compared to the Cabernet Sauvignon (87.91%); significant differences were recorded in the Negru compact variety (-3.26%).

In 2018 (Table 7), the highest values of the total ripened wood growth were recorded by the control variety - Cabernet Sauvignon (17.23 m), followed by the Vulpea variety (16.87 m), the Cabasmă neagră (16.24 m) and Negru compact with 15.37m.

Table 7

Total and matured one-year-old growths in local varieties and biotypes for red wine in 2018

Variety/Biotype	Total ripen wood/ vine (m)	Ripen wood /vine (m)	Ripen wood/ vine (%)	Ripen wood/ vine compared to the control (%)	Significance
Cabasmă neagră	16.24	14.41	88.73	-0.99	-
Negru compact	15.37	13.38	87.05	-2.67	0
Vulpea	16.87	14.78	87.61	-2.11	-
Cabernet Sauvignon (C)	17.23	15.46	89.72		

DL 5% = 2.56; DL 1% = 4.72; DL 0.1% = 8.03

The values for the total length of ripened wood on vine in 2018 allow the possibility to achieve a normal fruiting and pruning in all investigated varieties. As percentage approach, was found high values for all varieties, but lower compared to the control variety Cabernet Sauvignon.

The percentage values of ripened wood / vine in local varieties from the field trial split by years of research and the average of both years are presented in Table 8.

Table 8

Total and matured one-year-old growths in local varieties and biotypes for red wine (average 2017-2018)

Variety/Biotype	Buds viability (%)			Viable buds/ Difference compared with the control (%)	Significance
	2017	2018	Average 2017-2018		
Cabasmă neagră	86.53	88.73	87.63	-1.18	-
Negru compact	84.65	87.05	85.85	-2.96	0
Vulpea	85.01	87.61	86.31	-2.5	-
Cabernet Sauvignon (C)	87.91	89.72	88.81	-	

DL 5% = 2.92 DL 1% = 4.78; DL 0.1% = 8.07

Regarding the total and one-year-old wood, the average from two consecutive growing seasons (2017-2018), shows a high percentage for Cabasmă neagră (87.63%) and Vulpea (86.31%) varieties. A lower average percentage value was recorded for the Negru compact

variety, which also recorded significantly negative differences compared to the control variety.
Concerning the ripened wood growths, their quite high values allowed making pruning for adequate fruitfulness, and the unripened wood was eliminated with pruning.
The qualitative parameters of local grape varieties for red wines are presented in Tables 9 and 10. In all aspects studied for these parameters, the resulting values were lower compared with the control variety for all local varieties. Results were expected, due to the variety considered as control - Cabernet Sauvignon, which is a reference variety among the grape varieties for red wines.

Table 9

Qualitative parameters of red wine varieties and biotypes in 2017

Variety/Biotype	Sugars (g l^{-1})	Total acidity (g l^{-1} H_2SO_4)	Iga	Alc. Vol. %	Difference compared to the control (sugars g l^{-1})	Significance
Cabasmă neagră	161	4.3	37.44	9.47	-43	000
Negru compact	176	4.2	41.90	10.35	-28	00
Vulpea	180	4.5	40.00	10.58	-24	00
Cabernet Sauvignon (C)	204	4.7	43.40	12.00	-	-

DL 5% = 6.41; DL 1% = 11.82; DL 0.1% = 28.22

Sugars in 2017 ranged from 161 g l^{-1} in Cabasmă neagră, to 204 g l^{-1} in Cabernet Sauvignon. The accumulation of sugars of 176 g l^{-1} and 180 g l^{-1} in local varieties Negru compact and Vulpea respectively, allowed the production of wines with an alcoholic potential over 10% by volume. Acidity was close values in all varieties ranging from 4.2 (g l^{-1} H_2SO_4) to Cabasmă neagră and 4.5 (g l^{-1} H_2SO_4) in Cabernet Sauvignon.
In 2018, all the local varieties had lower values of sugars compared to the control variety; the lowest sugars level was recorded in the Cabasmă neagră variety (171 g l^{-1}), followed by Negru compact variety with sugar level of 182 g l^{-1} and Vulpea variety with 194 g l^{-1}. In 2018, the sugar concentration in the local grape varieties for red wines, was appropriate for wines with a higher alcohol level than the previous year, but for the category of red wines, can be considered as light wines of about 10.05% - 11, 41% alcohol.

Table 10

Qualitative parameters of red wine varieties and biotypes in 2018

Variety/Biotype	Sugars (g l^{-1})	Total acidity (g l^{-1} H_2SO_4)	Iga	Vol. Alc. %	Difference compared to the control (sugars g l^{-1})	Significance
Cabasmă neagră	171	4.2	40.71	10.05	-57	000
Negru compact	182	4.4	41.36	10.70	-46	000
Vulpea	194	4.3	45.11	11.41	-34	000
Cabernet Sauvignon (C)	228	4.5	50.66	13.41	-	-

DL 5% = 7.69; DL 1% = 14.51; DL 0.1% = 25.83

Regarding the quality of the grapes in the local varieties for red wines from this research, similar results were obtained in 2008-2010, when were studied in another PhD thesis [15], but it is appreciated the fact that during the approximately 9-10 years since the first research, these varieties kept their qualities thanks to the grape growers which applied the appropriate technology and preserve them in the vineyards even nowadays when there is a fierce competition among the wine varieties on the market.
Sugar concentration in grapes had lower values compared to the control variety with statistically significant differences. Sugar accumulations ranged from 171 g l^{-1} in Cabasmă neagră to 194 g l^{-1} in Vulpea variety.
Sladonja et al.2007 [20] found in Jarbola local variety from Croatia, during two growing seasons alcohol level of 11.6%, and total acidity between 7.4 – 8.8 g l^{-1}. The sugars concentration in Blauer Portugieser reported by Reščič et al. 2015 [18] ranged between 154 and 215 g l^{-1} and titratable acidity among 3.3 – 5.3 g l^{-1} g/l H_2SO_4 limits.

Table 11

Taste, flavour and colour of local wine varieties in 2018

Variety	Properties			
	Colour	**Flavour**	**Taste**	**Limpidity**
Cabasmă neagră	Dark red	Nice	Nice, velvety	Clear
Negru compact	Burgundy	Strong, Pepper	Slightly astringent, bitter	Clear
Vulpea	Dusty red	Nice	Green, Herbal	Clear

Small amounts of blended wines were achieved by classic technology of winemaking; the fermentation maceration stage on pomace being of 14 days for all varieties.

Most of the local varieties blended wines are described by a pleasant colour (Burgundy red in the Negru compact is the result of the dark black colour of the berry skin; dark red in Cabasmă neagră and dusty red in Vulpea variety which is recognized by unbalanced colour of the berry skin).

All wines were clear and had pleasant smell. Negru compact variety was different in astringency both in smell and taste.

Conclusions

Local varieties are still considered an important source of viticultural germplasm both in research and in practice; once identified must be preserved and respect as patrimony.

The results concerning the bud viability, the total and mature wood length, indicate that the local varieties have natural adaptation to the climatic conditions of the area, showing good resistance to frost and tolerate a normal pruning.

Generally, in all stages, the behaviour of the local varieties was similar to the years in which they were identified, namely 2008, 2009 and 2010, except for the phenophases of vegetation and for the percentage of viable buds due to the variability of climatic conditions.

The sugar concentration in the local varieties was lower compared to the control, but this was normal given the value of the Cabernet Sauvignon variety among the varieties of red wines.

Sugar concentration in grape juice and the conversion rate of sugars into potential alcohol, ranking local varieties in 2018 in the high quality wines class. Taste, flavour and colour ranked the local varieties in the top of the high quality wines.

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