

# Research on the fertility and production of some local grape cultivars from Alba County, Romania

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## Abstract

The research was carried out during 2021-2022 growing seasons and involved observations and determinations of several local grape cultivars identified in the wine-growing areas of Alba County. Twelve cultivars were selected for detailed viticultural research and were compared to control varieties which are representative in the research area. Four local cultivars were included in the group for white wines analysed in comparison to the control variety 'Fetească regală'. Other additional four local cultivars were grouped for red wines, and compared to the control variety 'Cabernet Sauvignon'. The remaining four local cultivars were grouped with those intended for table grapes. The cultivars were ranked based on their ampelographic characteristics and berries physico-chemical composition. Observations and analyses focused on the development of growing stages, fertility (e.g. fertile shoots rate, number of flowers per vine), grape yield, and berry quality (e.g. sugars content). One notable advantage of the local cultivars and biotypes included in the research was the very good resistance to diseases and pests, as well as lower input requirements compared to the control varieties, resulting in significantly lower production costs compared to the analysed controls.

**Keywords:** berry quality, local grape cultivars, red wines, table grapes, white wines

## Introduction

The grapevine, like other crops, evolved in three main periods: wild plants, old local varieties, and improved varieties [14]. During the age of wild plants, the vine was a component of the natural flora, limited to the evolutionary process influenced by natural selection, while humans were primarily concerned with harvesting the fruits and ploughing the soil. Viticultural germplasm is an alternative to developing grapevine varieties or using germ cells in vine improvement [8]. Furthermore, local cultivars contribute significantly to sustainable viticulture [7], requiring substantially fewer treatments to prevent diseases and pests [13].

The abundance of existing grapevine varieties reflects extensive and long selection work and confirms its significant predisposition to variability during the transition from wild to cultivated vine [3].

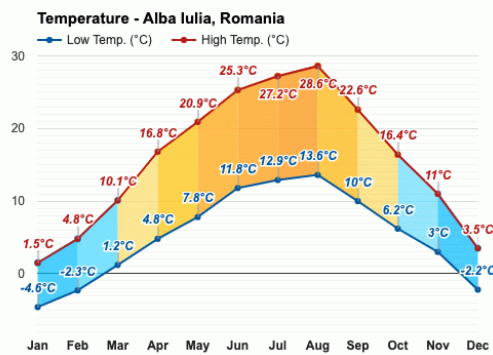
This transition was gradual but rather a protracted process characterized by successive and lengthy actions, including mutations, hybridizations, natural and artificial selection, and spatial isolations [8]. This process began with mutations that better suited human requirements, while previous natural hybridization, occurring before propagation by cuttings was established, further contributed to the consolidation of hereditary characteristics [2, 4]. Maraš et al. (2020) [8] describe a gradual transformation that involved mutations, hybridizations, natural and artificial selection, and spatial isolations [11]. The inception of this process involved mutations that better aligned with human requirements, while antecedent natural hybridization, predating the establishment of propagation by pruning, further contributed to the consolidation of hereditary traits [2, 4].

During the time of old local varieties, human intervention primarily involved propagating new forms that emerged in the natural flora, forms that nature might have otherwise eliminated without human care and protection [1]. This intervention altered the vine's natural trajectory, resulting in artificial selection superseding natural selection [6]. This change in direction accounts for the substantial differences between wild and

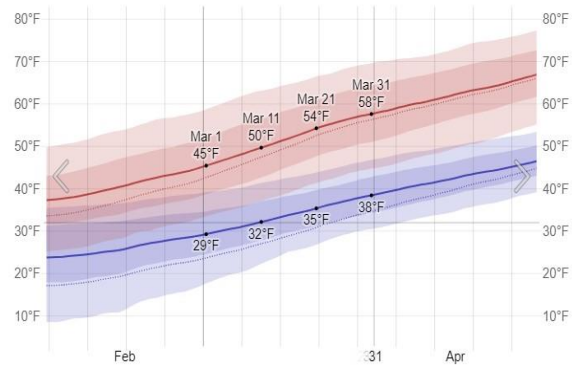
cultivated vines regarding the qualitative and quantitative traits, as well as the increased variability of cultivated vines.

### Material and Method

The study was conducted between 2021 and 2022 and involved observations and assessments of several local grape cultivars identified within the wine-growing regions of Alba County. Within these regions, a multitude of local grape cultivars were identified, from which a selection of 12 cultivars was deemed significant for viticultural investigation. These varieties were analysed in comparison to control varieties that are representative of their respective areas. Alba County boasts one of the largest vineyard areas in Romania, with nearly 3,000 hectares divided among the four existing vineyards: the Târnavelor Vineyard encompasses over half of this area, followed by the Alba Iulia Vineyard, Aiud Vineyard, and Sebeş-Apold Vineyard [15]. Situated at altitudes ranging from 175 to 544 meters, the vineyards experience significant variation in air temperature due to differences in altitude and exposure to western winds and solar radiation. Annual temperature averages range from 8.5°C in Alba Iulia, with the warmest month, July, ranging between 20 to 25°C, and the coldest month, January, dropping to approximately -33°C.



Date: 1991 - 2021 Min. Temperature °C (°F),  
 Max. Temperature °C (°F) (www.google.com)



Average High and Low Temperature in March in Alba Iulia (www.google.com)

(The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.)

Observations and determinations were conducted concerning various vegetation phases, including the percentage of fertile shoots, the number of inflorescences per vine, grape yield, and the sugar content in the grape must. The quality of production of the studied varieties was assessed by monitoring sugar content, with determinations made at berry full maturity under the prevailing climatic conditions of each year.

The sugar content in the must (expressed in g/l) was determined by using a Zeiss handheld refractometer. Quantitative production was assessed at harvest maturity through the counting and weighing of grape clusters for each cultivar. The average weight of one cluster was determined by individually weighing all clusters sampled from five vines for each cultivar. The results were then aggregated, and the total weight of all clusters was divided by the total number of clusters to derive the average weight of a cluster.

To ascertain the average number of clusters per vine, the total number of clusters was divided by the number of vines selected for each cultivar. Additionally, the average grape yield per cluster (kg/cluster) was calculated by multiplying the average weight of a cluster by the average number of clusters per vine.

### Results and Discussion

Late spring frosts are dangerous to early budding grapevine cultivars [5]. Therefore, the timing of growing stages in the vineyard, especially nowadays with high climate variability [10], is significantly important. When considering the phenological phases within the annual vine cycle, it becomes evident that delaying budding, shoot emergence, and flowering can help mitigate the risks of frost damage. For local cultivars intended for fresh consumption, budding occurs within an interval of 8-14 days, between April 9th and April 17th in 2021, and between April 13th and April 28th in 2022. Relative to the control cultivar, Fraguță albă and Mare aromatic cultivars exhibit earlier budding, while Frumos de Alba and Timpuriu cultivars bud 1-2 days before the control variety. Moreover, compared to the control, shoot emergence in all local cultivars is delayed

by 1-8 days. The flowering stage start 4-5 days earlier in Fragută albă and Mare aromatic cultivars, respectively, and 2-5 days later in Timpuriu and Frumos de Alba cultivars, compared to the control variety. Regarding full maturity, local cultivars used for fresh consumption are staggered over approximately a 20-day period, ensuring a month-long availability of fresh grapes.

**Table 1. Phenophases development in the local table grapes cultivars in 2021**

Local cultivar/ control variety	Phenological phase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Timpuriu	14.04	28.04	3.06	13.07	28.07	27.08
Frumos de Alba	17.04	29.04	6.06	10.07	2.08	11.09
Mare aromat	10.04	21.04	25.05	10.07	1.08	15.09
Fraguta alba	9.04	20.04	25.05	9.07	3.08	14.09
'Chasselas doré' (C)	12.04	19.04	1.06	17.07	2.08	8.09

**Table 2. Phenophases development in the local table grapes cultivars in 2022**

Local cultivar/ control variety	Phenological phase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Timpuriu	28.04	02.05	07.06	17.07	01.08	01.09
Frumos de Alba	21.04	03.05	10.06	14.07	06.08	15.09
Mare aromat	14.04	25.04	30.05	14.07	05.08	19.09
Fraguta alba	13.04	24.04	30.05	13.07	08.08	18.09
'Chasselas doré' (C)	16.04	23.04	05.06	21.07	06.08	12.09

**Table 3. Phenophases development in the local cultivars for white wines during 2021**

Local cultivar/ control variety	Phenological phase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Alb de Craciunel	19.04	28.04	5.06	20.07	16.08	21.09
Arămiu de Alba	21.04	28.04	7.06	23.07	19.08	26.09
Tămâioasă de Blaj	13.04	24.04	1.06	21.07	15.08	24.09
Galben aromat	18.04	28.04	6.06	22.07	18.08	26.09
"Fetească Regală" (C)	13.04	20.04	7.06	21.07	6.08	22.09

**Table 4. Phenophases development in the local cultivars for white wines during 2022**

Local cultivar/ control variety	Phenophase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Alb de Craciunel	23.04	02.05	10.06	24.07	20.08	25.09
Arămiu de Alba	25.04	02.05	11.06	27.07	23.08	28.09
Tămâioasă de Blaj	17.04	28.04	05.06	25.07	19.08	29.09
Galben aromat	22.04	02.05	10.06	26.07	22.08	30.09
'Fetească Regală' (C)	17.04	24.04	11.06	25.07	10.08	02.10

Concerning the local grape varieties used for white wine production, except for the local cultivar Tămâioasă de Blaj, the remaining varieties exhibit a delayed bud break of 4-9 days compared to the control variety. This delay mitigates the risk of shoot damage due to late spring frosts.

Additionally, flowering occurs 1-5 days earlier in the local cultivars compared to the control. Across all local cultivars for white wine, full maturity typically occurs around September 24-26. At this stage, the sugar concentration in the berries is adequate to produce wines of higher quality, while avoiding excessively alcoholic concentration.

**Table 5. Phenophases development in the local cultivars for red wines during 2021**

Local cultivar/ control variety	Phenological phase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Lacrima	10.04	23.04	27.05	13.07	11.08	21.09
Vechi de Alba	11.04	25.04	2.06	17.07	16.08	24.09
Rosu aromat	12.04	25.04	2.06	21.07	17.08	25.09
Rezistent negru	18.04	28.04	8.06	23.07	21.08	26.09
'Cabernet Sauvignon' (C)	22.04	04.05	12.06	29.07	22.08	28.09

**Table 6. Phenophases development in the local cultivars for red wines during 2022**

Local cultivar/ control variety	Phenophase					
	Budburst	Shoots emergence	Flowering	Berry set	Veraison	Maturity
Lacrima	14.04	27.04	31.05	17.07	15.08	25.09
Vechi de Alba	15.04	29.04	06.06	21.07	20.08	29.09
Rosu aromat	16.04	29.04	06.06	25.07	21.08	29.09
Rezistent negru	22.04	01.05	12.06	27.07	25.08	30.09
'Cabernet Sauvignon' (C)	26.04	08.05	16.06	02.08	26.08	02.10

The phenological phases of local grape cultivars used for red wine production started earlier compared to the control variety in both years of the study. This timing is crucial not only for avoiding frosts but also for integrating these cultivars into the winemaking process. Fertility is a critical trait that significantly influences the productivity of most plant species. Fortunately, grapevines generally exhibit high fertility rates, with over 70-80% of shoots being fertile in most cultivars. Varieties with higher percentages of fertile shoots are considered more valuable, according to Simeonov (2016) [12].

**Table 7. Results concerning fertility in local cultivars for table grapes (average 2021-2022)**

Local cultivar/ control variety	Percentage of fertile shoots	Number of inflorescences per vine	Difference compared to control	Significance
Timpuriu	82.5	11.85	-4.05	0
Frumos de Alba	71.5	34.25	+18.35	***
Mare aromat	81.5	32.15	+16.25	***
Fraguta alba	70.5	29.95	+14.05	***
'Chasselas doré' (C)	76.5	15.9	-	-

DL 5% 3.19                      DL 1% 6.12                      DL 0,1% 10.32

In the varieties for fresh consumption, the percentage of fertile shoots was high in all cultivars; however, there are evident differences among them. Mare aromat and Timpuriu cultivars stand out in this regard, with the growth of fertile shoots notably exceeding that of the control variety. Although the percentage of fertile shoots is satisfactory overall, Fraguta alba and Frumos de Alba cultivars exhibited slightly lower percentages compared to the control. Regarding the number of inflorescences per vine, except for the Timpuriu local cultivar, all other local cultivars clearly surpassed the control, with the observed differences demonstrating significant statistical significance. In the local cultivars for white wines, the percentage of fertile shoots is high; nevertheless, the values are slightly lower than those of the Feteasca regala control. The number of inflorescences on the vine is another productivity indicator that can complement or compensate for a lower percentage of fertile shoots [9]; the only local cultivar that recorded higher values than the control was Galben aromat.

In the local cultivars for red wines, all recorded percentages of fertile shoots were highest compared to the control. Among these, the cultivars Rezisent negru and Lacrima had percentages of fertile shoots more than 10% higher compared to the control. However, concerning the number of inflorescences per vine, the behavior of local cultivars was different. Vechi de Alba and especially Aromatic Red recorded lower results than the control, while Rezisent negru and Lacrima recorded values higher than the control, with the observed differences statistically significant.

**Table 8. Results concerning fertility in local cultivars for white wines (average 2021-2022)**

Local cultivar/ control variety	Percentage of fertile shoots	Number of inflorescences per vine	Difference compared to control	Significance
Alb de Crăcinel	76.5	15.05	-6.1	00
Arămiu de Alba	80.5	15.8	-5.7	00
Tămâioasă de Blaj	74.5	20.3	-0,75	-
Galben aromat	78.5	23.35	+2.3	*
'Fetească Regală' (C)	82.2	21.05	-	-
	DL 5% 2.21	DL 1% 4.08	DL 0.1% 7.13	

**Table 9. Results concerning fertility in local cultivars for white wines (average 2021-2022)**

Local cultivar/ control variety	Percentage of fertile shoots	Number of inflorescences per vine	Difference compared to control	Significance
Lacrima	78.5	22.15	+2.5	*
Vechi de Alba	75.5	19.45	-0.2	-
Rosu aromat	74.5	16.65	-3	0
Rezistent negru	79.5	23.85	+4.2	**
'Cabernet Sauvignon' (C)	67.5	19.65	-	-
	DL 5% 2.17	DL 1% 4.09	DL 0.1% 7.09	

Quantitative and qualitative production is extremely important parameter when referring to the grapevine, as to all cultivated plants [11]. In the cultivation of grapes for fresh consumption, the comparison regarding grape production was made with a valuable control, with high production potential. However, the local cultivars, in their vast majority, recorded close production values. In the case of the Timpuriu cultivar, the production level was higher than the control, with the difference statistically significantly positive. Although, within these cultivars, the accumulation potential of sugars is not as important as in for wine varieties, it is nevertheless noted that the level of accumulation in the Timpuriu cultivar was higher than the control, with the difference significantly positive. The rest of the cultivars recorded sugar content values lower than the control, but sufficient for these table grapes local cultivars.

**Table 10. Results regarding the grape yield and quality of table grape local cultivars (2021-2022 average)**

Local cultivar/ control variety	Grape yield (kg)	Grape must sugar amount (g/l)	Difference compared to control	
			Grape yield (kg)	Sugar (g/l)
Timpuriu	3.1	179.0	+0.3*	+14**
Frumos de Alba	2.6	149.0	-0.2 <sup>NS</sup>	-16***
Mare aromat	2.2	156.0	-0.6**	-9**
Fraga	2.7	143.0	-0.1 <sup>NS</sup>	-22***
'Chasselas doré' (C)	2.8	165.0	-	-
	Sugar DL 5% 3.95		DL 1% 8.42	DL 0.1% 15.11
	Grape yield DL 5% 0.21		DL 1% 0.43	DL 0.1% 0.9

**Table 11. Results regarding the grape yield and quality of local cultivars for white wine (2021-2022 average)**

Local cultivar/ control variety	Grape yield (kg)	Grape must sugar amount (g/l)	Difference compared to control	
			Grape yield (kg)	Sugar (g/l)
Alb de Craciunel	3.2	213.0	-0.2 <sup>NS</sup>	+14 <sup>**</sup>
Aramiu de Alba	3.9	194.0	+0.5 <sup>**</sup>	-5 <sup>NS</sup>
Tămâioasă de Blaj	2.8	193.0	-0.6 <sup>**</sup>	-6 <sup>*</sup>
Galben aromat	3.2	202.0	-0.2 <sup>NS</sup>	+3 <sup>NS</sup>
'Feteasca Regala' (C)	3.4	199.0	-	-
	Sugar DL 5% 5.37	DL 1% 9.74	DL 0.1% 16.23	
	Grape yield DL 5% 0.23	DL 1% 0.49	DL 0.1% 1.01	

**Table 12. Results regarding the grape yield and quality of local cultivars for red wine (2021-2022 average)**

Local cultivar/ control variety	Grape yield (kg)	Grape must sugar amount (g/l)	Difference compared to control	
			Grape yield (kg)	Sugar (g/l)
Lacrima	2.4	199.0	+0.1 <sup>NS</sup>	-7 <sup>*</sup>
Vechi de Alba	1,5	217.0	-0.8 <sup>**</sup>	+11 <sup>**</sup>
Rosu aromat	1.8	226.0	-0.5 <sup>**</sup>	+20 <sup>***</sup>
Rezistent negru	2.6	198.0	+0.3 <sup>*</sup>	-8 <sup>*</sup>
'Cabernet Sauvignon' (C)	2.3	206.0	-	-
	Sugars DL 5% 5.41	DL 1% 9.92	DL 0.1% 17.01	
	Grape yield DL 5% 0.18	DL 1% 0.38	DL 0.1% 0.89	

In local wine grape cultivations, production and, especially, its quality serve as crucial indicators for the success of a variety in niche markets [16]. Despite the control variety exhibiting exceptional results in the reference area, local varieties, with one exception (Tamaioasa de Blaj), recorded productions that were either close to or even superior to the control, particularly in Arămiu de Alba. In terms of the concentration of must sugars, all local cultivars achieved higher average parameters during the research, with the Alb de Crăciunel cultivar standing out by recording higher values compared to the control, with statistically significant differences. Regarding the performance of local cultivars for red wines, the recorded production varied widely, ranging from less productive cultivars (Vechi de Alba) to local cultivars that yielded productions surpassing the control level (Resistent negru and Lacrima). The qualitative potential, assessed based on the sugar content of the must, showcased high values across all local cultivars, attributed in part to global warming and the increase in insolation in recent years. Notably, Aromatic Red and Vechi de Alba distinguished themselves by recording sugar values in the must higher than the control, despite the latter being considered a variety with high accumulation potential.

### Conclusions

The researched wine-growing area is well-known for offering highly favourable natural conditions for vine cultivation, boasting a rich tradition and history in viticulture. The Alba Iulia vineyard is renowned as one of Romania's oldest vineyards. Consequently, it is commonplace to find vine plantations of varying sizes in the yards or gardens of residents, featuring both popular and numerous local cultivars. Among these, several valuable varieties stand out, exhibiting excellence in grape quality and resilience against diseases and pests, even under minimal cultivation practices where treatments are often limited to one or two sprays of copper sulphate at most. Although the local grape cultivars for winemaking were compared to highly esteemed control varieties, the results obtained were remarkably promising across all analyzed indicators, particularly in terms of grape quality. Noteworthy local varieties include Aromatic Red, Vechi de Alba, Galben aromat, and Alb de Crăciunel. Furthermore, the majority of local cultivars demonstrate robust resistance to diseases and pests, rendering them compelling options for both organic viticulture (which is gradually gaining traction in Romania) and as parent cultivars in vine improvement process.

## References

- [1] Avramidou, E.V., Masaoutis, I., Pitsoli, T.D., Kapazoglou, A., Pikraki, M., Trantas, E. A., ... & Doulis, A.G. (2023), *Analysis of Wine-Producing Vitis vinifera L. Biotypes, Autochthonous to Crete (Greece)*, Employing Ampelographic and Microsatellite Markers. *Life*, 13(1), 220.
- [2] Brunori, E., Cirigliano, P., & Biasi, R. (2015), *Sustainable use of genetic resources: the characterization of an Italian local grapevine variety (Grechetto rosso) and its own landscape*. *VITIS-Journal of Grapevine Research*, 54, 261-264.
- [3] Diago, M. P., Sanz-Garcia, A., Millan, B., Blasco, J., & Tardaguila, J. (2014), *Assessment of flower number per inflorescence in grapevine by image analysis under field conditions*. *Journal of the Science of Food and Agriculture*, 94(10), 1981-1987.
- [4] Dobrei, A., Dobrei, A.G., Nistor, E., Iordanescu, O.A., & Sala, F. (2015), *Local grapevine germplasm from Western of Romania-An alternative to climate change and source of typicity and authenticity*. *Agriculture and Agricultural Science Procedia*, 6, 124-131.
- [5] Dry, I.B., Davies, C., Dunlevy, J.D., Smith, H.M., Thomas, M.R., Walker, A.R., ... & Clingeffer, P.R. (2022), *Development of new wine-, dried-and table grape scions and rootstocks for Australian viticulture: past, present and future*. *Australian Journal of Grape and Wine Research*, 28(2), 177-195.
- [6] Grigoriou, A., Tsaniklidis, G., Hagidimitriou, M., & Nikoloudakis, N. (2020)., *The Cypriot indigenous grapevine germplasm is a multi-clonal varietal mixture*. *Plants*, 9(8), 1034.
- [7] Ibrahim, H.U., & Bayir, A. (2010), *Distribution of wild and cultivated grapes in Turkey*. *Notulae Scientia Biologicae*, 2(4), 83-87.
- [8] Maraš, V., Tello, J., Gazivoda, A., Mugoša, M., Perišić, M., Raičević, J., ... & Ibáñez, J. (2020), *Population genetic analysis in old Montenegrin vineyards reveals ancient ways currently active to generate diversity in Vitis vinifera*. *Scientific reports*, 10(1), 1-13.
- [9] Nistor, E., Dobrei, A. G., Dobrei, A., Camen, D., Velicevici, G., & Prundeanu, H. (2017), *The influence of site environment on bud development and fruitfulness in some grapevine varieties*. *Journal of Horticulture, Forestry and Biotechnology*, Volume 21(4), 68- 72.
- [10] Palliotti, A., Tombesi, S., Silvestroni, O., Lanari, V., Gatti, M., & Poni, S. (2014), *Changes in vineyard establishment and canopy management urged by earlier climate-related grape ripening: A review*. *Scientia Horticulturae*, 178, 43-54.
- [11] Poni, S., Gatti, M., Palliotti, A., Dai, Z., Duchêne, E., Truong, T. T., ... & Tombesi, S. (2018). *Grapevine quality: A multiple choice issue*. *Scientia horticulturae*, 234, 445-462.
- [12] Simeonov, I. (2016), *Concise economic description of the basic local grapevine varieties for the Republic of Bulgaria*. *Phytologia balcanica*, 22(2), 209-216.
- [13] Stănuș (Rujoiu) Mirela, Dobrei Alina Georgeta, Scedei Daniela, Nistor Eleonora, Dobrei Alin, (2023), *Identification of some wine germoplasma sinks from Alba county for the production of authentic wine products through the application of some minimally invasive technologies*, *Journal of Horticulture, Forestry and Biotechnology*, Vol.27(3)
- [14] Storey, S.G., Malan, A.P., & Hugo, H.J. (2017), *Nematode pests of grapevine*. *Nematology in South Africa: a view from the 21st century*, 325-343.
- [15] Țimonea D., (2013), *Alba on the viticulture map: four vineyards and thousands of hectares planted with vines*, <https://adevarul.ro/stiri-locale/alba-iulia/alba-pe-harta-viticulturii-patru-podgorii-si-mii-1450634.html> (in Romanian)
- [16] Zombardo, A., Meneghetti, S., Morreale, G., Calò, A., Costacurta, A., & Storchi, P. (2022), *Study of inter- and intra-varietal genetic variability in grapevine cultivars*. *Plants*, 11(3), 397.