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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 analyzed 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 analyzed controls.

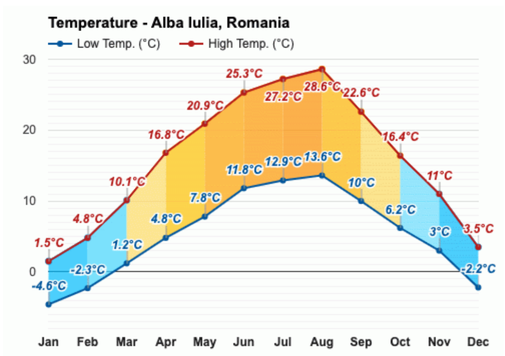
• Introduction

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].

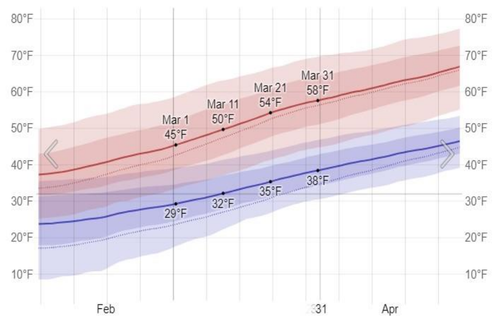
- The abundance of existing grapevine varieties reflects extensive and long selection work and confirms its significant predisposition to variability during the transition from wild to cultivated vine [3].
- This transition was gradual but rather a protracted process characterized by successive and lengthy 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 analyzed 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 Sebeș-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 cluster 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 discussions

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, Fragută 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.

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	0305	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 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

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
Tâmâioasă 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
"Feteasca Regală" (C)	13.04	20.04	7.06	21.07	6.08	22.09

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
Tâmâioasă 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	30.0

Concerning the local grape varieties used for white wine production, except for the local cultivar Tâmaioasă 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.

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

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].

Results concerning fertility in local cultivars for table grapes (average 2021-2022)

Local cultivar/ control variety				
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	-	-

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)	Grape yield (kg)	Sugar (g/l)
Timpuriu	3.1	179.0	+0.3*	+14**
Frumos de Alba	2.6	149.0	-0.2 ^{NS}	-16***
Mare aromat	2.2	156.0	-0.6**	-9**
Fraga	2.7	143.0	-0.1 ^{NS}	-22***
'Chasselas doré' (C)	2.8	165.0	-	-

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.