

## ASSESSMENT AND RANKING THE GRAPEVINE VARIETIES FOR WINE CULTIVATED IN ODOBEȘTI VINEYARD BY AN ANALYTICAL HIERARCHICAL PROCESS

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### INTRODUCTION

Odobesti vineyard, is located in the Hills of Moldova viticultural region, near other eleven vineyard (Cotnari, Iași, Huși, Colinele Tutovei, Delul Bujorului, Nicorești, Ivești, Covurlui, Zeletin, Panciu, Cotești) and eight independent viticultural centers (according to the Order no. 1205/2018 for approval of the Nomination of wine-growing areas and classification of localities by wine-growing regions, vineyards and wine center).

Hills of Moldova viticultural region is profiled on the production of table white and red wines, high quality white wines, natural sweet wines (Cotnari vineyard) and raw material wines for sparkling wines (in Panciu and Ivești vineyards). The production of red wines has an insular character in the Hills of Moldova (Colinele Tutovei vineyard – Iana center; Iași vineyard – Uricani center; Dealul Bujorului, Nicorești, Ivești vineyards (Stroe, 2012). According to EU growing zone type, Hills of Moldova Viticultural Region is located in CI wine zone (CEE 479/2008). The area delimited for the geographical indication “Dealurile Moldovei” includes a number of 9 vineyards, but Odobesti vineyard is not included among them ([http://www.onvpv.ro/sites/default/files/caiet\\_sarcini\\_ig\\_dl\\_moldovei\\_modif\\_cf\\_cererii\\_1427\\_14.06.2019\\_track\\_changes.pdf](http://www.onvpv.ro/sites/default/files/caiet_sarcini_ig_dl_moldovei_modif_cf_cererii_1427_14.06.2019_track_changes.pdf))

One of the oldest vineyards in the country, Odobesti vineyard is located in the eastern Part of the Curvature Sub Carpathians, has the middle section of Vrancea vineyards, with a width of 5-10 km and a length of about 30 km, between Putna valley in the northern part and Milcov Valley to the south. Administratively, Odobesti vineyard is located in Vrancea county (Fig. 1, 2).

The viticultural centers of the vineyard are Odobesti, Jariștea and Bolotești. The climate is of temperate continental type and due to the long presence of the Eastern European air masses it presents excessive nuances. However, the values of the climatic indices register high and beneficial values for the grapevine growing (379 mm precipitation during the vegetation period, the sum of the hours of sunshine of 1508 hours, the balance of

global temperatures 3390°C) and the vegetation period is 184 days (Stroe, 2012). According to the data of Odobesti Viticultural Research Station, in the last 40 years there has been a global warming in this region.

([https://www.madr.ro/docs/cercetare/Rezultate\\_activitate\\_de\\_cercetare/SC-DVV\\_Odobesti\\_-\\_Portofoliul\\_de\\_soieri\\_si\\_clone.pdf](https://www.madr.ro/docs/cercetare/Rezultate_activitate_de_cercetare/SC-DVV_Odobesti_-_Portofoliul_de_soieri_si_clone.pdf)).



Fig. 1. Location of Vrancea County, Romania  
[https://en.wikipedia.org/wiki/Vrancea\\_County](https://en.wikipedia.org/wiki/Vrancea_County)



Fig. 2. Vrancea County  
<https://psrvrancea.files.wordpress.com/2012/05/vn1.jpg>

The pedological background consists of: cambic chernozems, greic phaeozem, aluviosol (entic and eutric), cernic greic phaeozem (Toti et al., 2017).

The relief is wavy, hilly, with altitudes between 100 m to east and 300 m to west.

The old assortment consisted of the Galbenă de Odobești, Plăvaie, Negru vârtos, Vulpe varieties, and of the table group of Razachie, Coarnă albă, Coarnă neagră varieties ([https://www.onvpv.ro/sites/default/files/pdfs/caiet\\_s\\_arcini\\_doc\\_odobesti\\_316ro.pdf](https://www.onvpv.ro/sites/default/files/pdfs/caiet_s_arcini_doc_odobesti_316ro.pdf)).

The current vineyard is profiled wines production, especially white wines among the varieties existing in culture are mentioned Fetească regală and Aligoté, from which white table wines are obtained, and to obtain high quality white wines are Fetească albă, Riesling italian, Sauvignon, Muscat Ottonel cultivars. It is said that the wines of this vineyard are in third place due to their freshness and nobility, after the wines of Cotnari and Huși. Red table wines are obtained, especially from Băbească neagră variety, but also high quality wines from the Merlot, Fetească neagră, Cabernet Sauvignon, Pinot noir varieties.

In the Bolotești viticultural center, aged wine distillates are obtained from Mustoasă de Măderat, Fetească regală, Plăvaie and Galbenă de Odobești grapevine cultivars. Chasselas doré and Chasselas roze, Coarnă neagră, Coarnă albă, Muscat de Hamburg and Cinsaut varieties are grown from the group of table grape varieties. In Odobești vineyard is practiced the mixed cutting system, with long canes, on semi-high forms. (Stroe, 2012)

This study deals with the application of the analytical hierarchical process (AHP) for assessing and ranking some grapevine varieties of wine grown in Odobești vineyard, taking into consideration the tradition of the zone and the climate conditions changing.

AHP have been previously used to evaluate and rank grapevine varieties grown in the viticultural regions Hills of Banat (Buciumeanu et al., 2020a) and Danube Terraces (Buciumeanu et al., 2020b), and vineyards Huși (Vizitiu et al., 2020) and Calafat (Buciumeanu et al., 2020c).

## MATERIAL AND METHOD

The grapevine varieties (*Vitis vinifera* L.) studied by AHP in this work are for white wine (Galbenă de Odobești, Fetească albă, Fetească regală, Aligoté, Sauvignon, Riesling italian) and red wine (Alicante Bouschet).

AHP is one of the most used multicriteria decision making tool. It can provide an average position of a decision of variants and criteria visualization for entering in a hierarchy. Also, AHP relies on the judgments of experts to derive priority scales (Saaty, 1977; 2008).

In order to determine the most important grapevine varieties for Odobești vineyard, 16 criteria with a scale of 7 levels each were used in the AHP exercise. These 16 criteria were used elsewhere to identify the most important grapevine varieties from Calafat vineyard (Buciumeanu et al., 2020c).

In order to determine the most important grapevine varieties for Odobești vineyard, 16 criteria were established, as follows: 1. Harvesting period; 2. Portfolio of derived products; 3. Harvested quantity by one worker in 8 hours; 4. Harvesting cost; 5. Knowledge for recognition; 6. Knowledge for harvesting; 7.

Tools needed for harvesting; 8. Complexity of harvesting process; 9. Distribution range; 10. Market potential; 11. Transport from the harvesting point to the storage center; 12. Perishability; 13. "Celebrity" of the product on the market; 14. Biotic threats; 15. Abiotic threats and 16. Development of the process of harvesting.

These criteria with high a degree of generality have been also used in other fields of research: in the case of forest fruits (Vechiu and Dincă, 2019; Enescu and Dincă, 2020), non-wood forest products (Blaga et al., 2019; Cântar and Dincă, 2019; Tudor and Dincă, 2019; Pleșca et al., 2019) and for wild animals (Ciontu et al., 2018; 2019).

The analyses were achieved using the Expert Choice Desktop software (v. 11.5.1683).

## RESULTS AND DISCUSSION

The Order No. 225/2006 regarding the approval of Zoning noble grapevine species admitted in culture in Romania's viticultural areas mention all six grapevine genotypes for white wine taken into the study (Galbenă de Odobești, Fetească albă, Fetească regală, Aligoté, Sauvignon, Riesling italian) as being zoned for Odobești vineyard.

Alicante Bouschet variety is found in almost all vineyards where red wines of wide consumption are produced (Constantinescu et al., 1959).

The AHP alternative ranking, resulted from experts' judgment, is presented in Table 1.

According to the AHP results, the grapevine varieties with the highest potential for Odobești vineyard were: Galbenă de Odobești, Aligoté and Fetească albă (Figure 3).

Wines and wine products with Odobesti designation of origin include several varieties, among which Galbenă de Odobești, Aligoté and Fetească albă.

The sum of active temperature in Odobești vineyard being 3390°C and growing season of 184 days, the area is very suitable for the cultivation of selected grapevine varieties (Stroe, 2012). The ripening of the Galbenă de Odobești grapes is completed in September and the first half of October (epoch V-VI).

Table 1. The AHP alternative ranking

Crite- rion	Grapevine varieties						
	Galbenă de Odobesti	Fetească albă	Fetească regală	Aligoté	Sauvi- gnon	Riesling italian	Alicante Bouschet
1.	7	1	4	5	6	2	3
2.	5	6	7	2	4	3	1
3.	7	1	4	3	2	5	6
4.	1	4	2	7	6	5	3
5.	4	3	5	2	6	7	1
6.	7	5	6	2	3	4	1
7.	1	3	2	4	5	6	7
8.	3	2	1	4	5	6	7
9.	7	6	5	2	3	4	1
10.	7	4	6	3	2	5	1
11.	3	5	1	6	2	4	7
12.	7	6	2	4	3	1	5
13.	7	6	3	2	5	4	1
14.	7	6	1	2	5	4	3
15.	2	3	5	7	1	4	6
16.	7	6	3	5	4	2	1

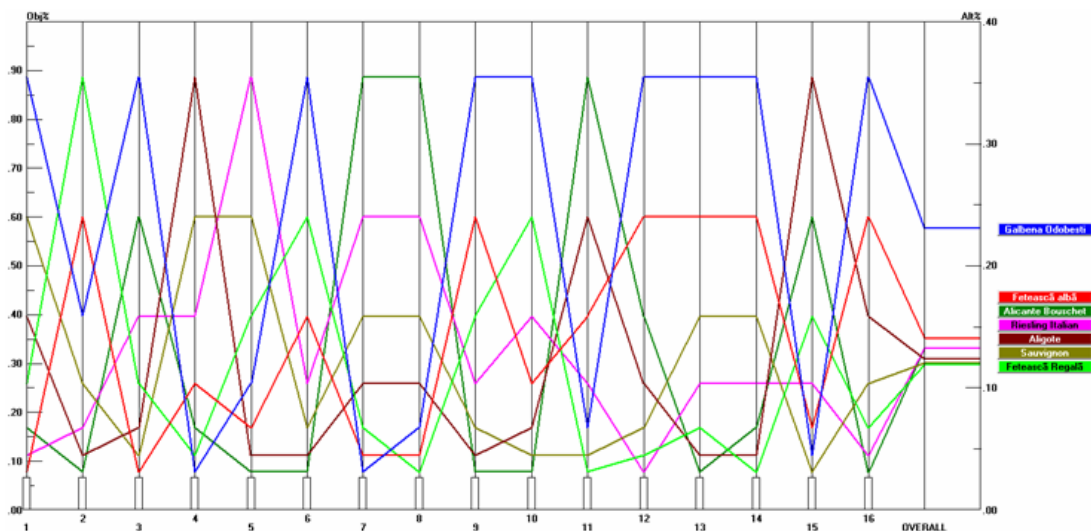


Fig. 3. The ranking of the seven grapevine varieties (Galbenă de Odobești, Fetească albă, Fetească regală, Aligoté, Sauvignon, Riesling Italian, Alicante Bouschet) cultivated in Odobești vineyard

The full ripening of Aligoté grapes takes place earlier in the Bucharest region and Dealu Mare vineyard, where the vegetation processes take place at a faster rhythm than in the rest of the country's regions.

In Odobești vineyard, the Aligoté variety ripens in 15-25 September period. The ripening of Fetească albă grapes ends during September, and in some years in the first decade of October. In 1946, a very droughty year, Fetească albă variety ripened in the third epoch (August 15-30) in Bucharest and Odobești (Constantinescu et al., 1959) (Table 2).

The analysis and correlation of the climatic factors variation during the grapes maturation with their composition characteristics have a determinative influence on the quality of the obtained wines.

Galbenă de Odobești, Aligoté and Fetească albă grapevine varieties show different resistance to biotic and abiotic stress factors (Table 3).

Table 2. Crossing the vegetation cycle for Galbenă de Odobești, Aligoté and Fetească albă grapevine varieties (adapted after Constantinescu et al., 1959).

Grapevine variety	Crossing the vegetation cycle		
	The balance of global temperature (°C)	Days (No.)	Grapes ripening (Epoch)
Galbenă de Odobești	2800-3600	180-200	V-VI
Aligoté	3300-3500	180-200	V
Fetească albă	2500-3400	160-195	IV-V-VI

Table 3. Behavior of Galbenă de Odobești, Aligoté and Fetească albă grapevine varieties to different stress factors (adapted after Constantinescu et al., 1959; Stroe, 2012)

Grapevine varieties	Drought	Cold	Downy mildew	Powdery mildew	Gray mould	Mites	Moths	Hornets	Birds
Galbenă de Odobești	Sensitive	Sensitive	Resistant	sensitive	High sensitive	Resistant	Resistant	-	Resistant
Aligoté	Good Resistance	Good tolerance	Medium resistance	Medium resistance	Sensitive	Good resistance	Sensitive	Resistant	-
Fetească albă	Resistant	Resistant	High sensitive	High sensitive	Sensitive	High sensitive	Resistant	-	Sensitive

#### *Galbenă de Odobești variety*

The variety has a low ecological plasticity, it is cultivated only in 4 viticultural centers, located in the south of Vrancea, but it has the best results in the Odobești viticultural center. It is a variety suitable for hilly regions, with high production potential, where the aim is to obtain big yields, but it is not suitable for lowland regions because the harvest is harmed by diseases and pests. Galbenă de Odobești is one of the most fertile varieties. In the conditions of Odobești vineyard it has 22.5% fertile shoots, the absolute fertility coefficient is 1.8 and the relative one 1.2, and the absolute fertility index is 337 and the relative one is 208. This big variation is determined by the cutting system and scattered lead, in double planes, which creates unequal conditions for the growth and fruiting of the shoots. In almost all years, when the variety is cultivated on sloping lands with southern exposure, the maturation of the wood is ensured. Being a productive variety, it gives big yields wherever it is cultivated. From this point of view, it is among the most valuable varieties. In the conditions of Pietroasa viticultural center and Odobești vineyard, average productions of 14057 and 15215 kg of grapes/ha were obtained, the maximum productions being of 16288 and 16477 kg/ha respectively. Galbenă de Odobești variety produces an ordinary, light, refreshing table wine, its quality being better when the culture is closer to Odobești, the origin place (Constantinescu et al., 1959). The variety has a low sugar storage capacity (160 - 165 - 170 g/l). The acidity varies between 4.6 and 6.0% H<sub>2</sub>SO<sub>4</sub> (Stroe, 2012). Being a very old variety in culture, at Odobești Viticultural Research Station, two clones were obtained from its population: Galbenă de Odobești 33 Od. and Galbenă de Odobești 50 Od., the first being distinguished by a higher production as compared to the population, and the second by a higher potential for sugar accumulation (Stroe, 2012; Oprea, 2019).

#### *Aligoté variety*

Being a very productive variety and offering good material for consumer wines, it has expanded in culture in the steppe area of Moldova (Botoșani, Iași, Vaslui, Huși, Bârlad, Tecuci, Galați) and in the area of curvature of the Carpathians (Troțușului valley, Panciu, Odobești, Râmnicu Sărat). It is a variety of high production. Subjected to mixed and common agrotechnical pruning, it gave 95% fertile shoots on average, having an absolute fertility coefficient of 2.5

and a relative one of 2.4. The absolute productivity index has an average value of 280, and the relative one of 269. In Odobești vineyard the absolute fertility coefficient has an average value of 2.2 and the relative one of 1.7. The absolute productivity index varies between 259 and 300, and the relative one between 197 and 245. Aligoté variety gives good results in the forest-steppe regions and on the coastal lands. As well, the cultivation of this variety can be done on clay-sandy soils and even on sands. It generally prefers sloping lands with southern or south-western exposure. In colder regions the southern exposure is most indicated. The best results are obtained in colder but not too humid conditions, where the grapes ripen slowly, the acidity remaining higher, and obtained wine being more balanced. This fact explains its wide spread in Moldova. The Aligoté variety has the highest acidity in the Odobești vineyard, where the ripening takes place more slowly every year. Having a high sugar content, it turns out that under the report of the baking season Aligoté finds here the best conditions. The production is high, varying depending on the pedoclimatic conditions. In high density plantations, an average of 25000 kg of grapes/ha are obtained. Maximum yields can reach 40000 kg/ha (Constantinescu et al., 1959). Aligoté variety has a low sugar storage capacity (170 - 200 g/l) and the acidity is 4.7% H<sub>2</sub>SO<sub>4</sub> (Stroe, 2012).

#### *Fetească albă variety*

Fetească albă variety is widespread in all vineyards, especially in Transylvania and Moldova, where it gives the best results. In the Odobești conditions it has 64.1% fertile shoots. The average value of the absolute fertility coefficient is 1.8, and of the relative one 1.2. The absolute productivity index reaches 227 and the relative one 150. In conditions of cultivation on hills, the maturation of the wood is ensured, to which the earliness of the variety also contributes. Fetească albă succeeds well in the more northern vineyards, where the grapes ripen more slowly, being able to accumulate maximum sugars, without the acidity being lowered than normal. The variety gives medium yields. In the conditions of Bucharest, Odobești and Istrița, productions were obtained varying between 14787 and 18338 kg of grapes / ha (Constantinescu et al., 1959). In general, the production obtained is small, 5000 - 7000 kg/ha, rarely higher yields are obtained (10000 - 11000 kg / ha). One of the reasons for the small production is the

fact that biotypes with different floral anomalies have appeared in the population. It is a good accumulating of sugar variety (200 - 240 g/l), and the acidity in the northern areas is good, around 5.6 %  $H_2SO_4$ , observing a decrease in the southern areas, due to the acid combustion. At Odobești Viticultural Research Station, two clones were obtained from Fetească albă population: Fetească albă 1 Od. and Fetească albă 144 Od., with grapes ripening in the IV epoch and productions of more than 16 t/ha and 14 t/ha, respectively. These clones are recommended to expand in culture in the vineyards of southern Moldova (Odobești, Panciu, Cotești) (Stroe, 2012; [https://www.madr.ro/docs/cercetare/Rezultate\\_activitate\\_de\\_cercetare/SC-DVV\\_Odobești\\_-\\_Portofoliul\\_de\\_soiuri\\_si\\_clone.pdf](https://www.madr.ro/docs/cercetare/Rezultate_activitate_de_cercetare/SC-DVV_Odobești_-_Portofoliul_de_soiuri_si_clone.pdf)).

## CONCLUSIONS

According to AHP results, based on pairwise The result of the AHP exercise confirmed the value of the Galbenă de Odobești, Aligoté and Fetească albă grapevine varieties of white wines for the Odobești vineyard, as well as for the Romanian viticulture. Odobești vineyard, one of the oldest vineyard in the country, benefits of favorable ecoclimatic conditions for grapevine cultivation. The application of the AHP results can contribute to a durable viticulture development, quality wines production and a more reliable future of this grapevine growing area. Every grapevine growing zone can be analysed by Expert Choice software combined with AHP to evaluate and rank the most suitable grapevine varieties of wines and table grapes, in order to create a profitable market given the need to adapt the viticulture to climate changes and, also, to the evolution of consumer preferences.

## ABSTRACT

The aim of the work was the application of the analytical hierarchical process (AHP) for assessing and ranking seven grapevine varieties (*V. vinifera* L.) of wine grown in Odobești vineyard (Galbenă de Odobești, Fetească albă, Fetească regală, Aligoté, Sauvignon, Riesling italian, and Alicante Bouschet), taking into consideration the tradition of the zone. AHP is one of the most used multicriteria decision making tool. It can provide an average position of a decision of variants and criteria visualization for entering in a hierarchy. In the AHP exercise, 16 criteria having a high degree of generality, with a scale of 7 levels each have been used. Among these criteria were included: the request on the market, knowledge for recognition, and biotic and abiotic threats that can influence the crop. The analyses were obtained using the Expert Choice Desktop software (v. 11.5.1683). According to the results, the grapevine varieties selected with the highest potential for Odobești vineyard were Galbenă

de Odobești, Aligoté and Fetească albă. These three varieties are zoned for the Odobești vineyard and capitalize very well the pedoclimatic characteristics of this grapevine growing area. Knowing that Odobești is one the oldest vineyards in the country and currently it is profiled on white wines production, especially, the study can contribute to the establishment of a durable viticulture, production of quality wines and a more reliable future of this viticultural area.

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