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DURABLE VITICULTURE DEVELOPMENT IN DRĂGĂȘANI VINEYARD BY USE THE AHP METHOD TO ASSESSS AND RANK THE MOST SUITABLE GRAPEVINE VARIETIES

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Abstract

The work was intended to identify the most valuable grapevine varieties for Drăgășani vineyard by means of an analytical hierarchical process (AHP). Eight grapevine varieties zoned for this grapevine growing area were included in the AHP exercise: Negru de Drăgășani, Pinot Noir (for red wines), Crâmpoșie selecționată, Sauvignon, Pinot Gris, Fetească regală, Riesling Italian (for white wines) and Azur (for table grapes). Of these, the results recommended Crâmpoșie selecționată, Negru de Drăgășani and Azur as the most valuable varieties in Drășășani vineyard. These varieties can develop the viticulture in Oltenia and, also, in Romania, offering local alternatives for wine and table grapes. The analyses were carried out using the Expert Choice Desktop software package.

Key words*:* analytical hierarchical process, pairwise comparison, *Vitis*, durable viticulture, wine region IIII.

INTRODUCTION

Drăgășani vineyard is part of Hills of Vallachia and Oltenia viticultural region (Region III). There are four wine centers within the vineyard: Drăgășani, Gușoeni, Măciuca (in Vâlcea county), Iancu Jianu (in Olt county) (Order no. 1205/ June 22, 2018 for the approval of the Nomination of the viticultural areas and the classification of the localities by viticultural regions, vineyards and wine centers).

Drăgășani vineyard, the oldest and most famous in the Carpatho-Danubian area of Oltenia, includes the lands located between the Getic Subcarpathians to the north and the Romanian Plain to the south and south-east, being found between the parallels 44°30' and 44°55' northern latitude and meridians 23º55' and 24º15' eastern longitude. The territory of the vineyard, which covers an area of 16,000 ha, is located on the terraces and slopes of the subunit known as the Olteţ Plateau (Figure 1). The age of the vineyards can not be specified, being the first plantations made by the Geto-Dacians.

Depending on the grapevine growing areas established at the European Union level, Drăgășani vineyard is located in the C I wine zone (Bucur, 2011).

Figure 1. Map of vineyards in Romania
Source: https://guideandtravel.pl/en/w-wine/

The climate is of moderate continental temperate type, generated by the geographical

position, where some mediterranean influences from the south and south-west are felt, which generate a closeness in climate terms with the Dealu Mare vineyard, especially in terms of heliothermic resources. The relatively large distances between the centres determine appreciable differences from this point of view, the smallest heliothermic resources being registered in the north of the vineyard, and the largest in the southern part. The sum of the hours of sunshine during the active vegetation period is 1,660 hours, the global thermal balance is 3,400°C, and the annual rainfall is 480 mm, with an uneven distribution, most falling in the spring and autumn. Excessive rainfall in autumn favours the attack of rot, which in some years leads to a decrease production of about 50%. The hail is also very common (Stroe, 2012). Spring hoar-frosts and frosts are relatively common around April 20th (Popa et al., 2015).

An important beneficial influence on the vineyard has the Olt river, Drăgășani vineyard being located on its right side (60 km long and 20 km wide), and on the terraces and hillocks from the river basin of its affluents (Pesceana, Dâlga, Mamu, Beica, Cerna, Olteț) (Gheorghiță et al., 2016).

The relief consists of hills and hillocks with altitudes ranging from 200-300 m to 400-500 m (Figure 2).

Figure 2. Image from Drăgășani vineyard (original)

In this vineyard there is a large variety of soils, as: Eutricambosol, Stagnic Luvosols, Aluvisols, Geoerodic Regosols, Aluvisols (Entic, Batigleic), Vertosols, Gleisols (Toti et al., 2017).

Regarding the production direction, the old assortment that brought the fame of this vineyard consisted of the varieties: Crâmpoşie, Braghină, Gordan, Tămâioasă românească for white wines, and for red wines: Negru moale, Negru vârtos, as well as some local varieties: Balaban, Roşioară, Slaviţă. Currently, in the Drăgășani vineyard, due to the diversity and variability of the ecological conditions, the production directions are also different, the assortment being mainly made up of wine varieties and to a small extent, of table grape varieties (Stroe, 2012; https://www.agro.basf.ro/ro/stiri/fermier-in-romania/ghidul-principalelor-regiuni-viticole-si-podgorii-din-romania.html). Mention the zoned varieties for the Drăgășani vineyard as follows: for white wines - Chardonnay, Crâmpoșie selecționată, Fetească regală, Pinot gris, Riesling italian, Sauvignon, Vilarom; for flavored wines - Negru aromat, Șarbă, Tămâioasă românească, Muscat Ottonel and for red wines - Alutus, Cabernet Sauvignon, Merlot, Negru de Drăgașani, Novac, Pinot Noir. From the group the table grapes, the zoned varieties are: Victoria, Augusta, Azur, Călina, Muscat D'Adda, Muscat de Hamburg (Order no. 225/2006 for the approval of the Zoning of noble fruitful grapevine varieties admitted for cultivation in the viticultural areas of Romania).

The aim of this work is the application of a hierarchical methodology (AHP) to give a scientific contribution to a durable viticulture, by assessing and ranking some grapevine varieties of white and red wine, and table grapes that exploit well the potential of the Drăgășani vineyard.

MATERIALS AND METHODS

In this work AHP was used to study eight grapevine cultivars (*Vitis vinifera* L.), belonging to the following production directions: red wine (Negru de Drăgășani, Pinot Noir cvs.), white wine (Crâmpoșie selecționată, Sauvignon, Pinot Gris, Fetească regală, Riesling Italian cvs.) and table grapes (Azur cv.).

AHP is a multi-criteria decision-making method consisting of the decomposition of the decision problem into simpler components or levels and the definition of a hierarchy setting by pairwise comparison between the proposed levels (Saaty, 1977).

In order to determine the most important grapevine varieties for Drăgășani vineyard, 16 criteria with a scale of 8 levels each were used in the AHP exercise, as follows: criterion 1 - harvesting period (from 1: the shortest harvesting period to 8: the longest harvesting period); criterion 2 - portfolio of derived products (from 1: the smallest number of derived products to 8: the highest number of derived products); criterion 3 - harvested quantity by one worker in 8 hours (from 1: the lowest quantity to 8: the highest quantity); criterion 4 - harvesting cost (from 1: the lowest cost to 8: the highest cost); criterion 5 - knowledge for recognition (from 1: most recognizable product to 8: hardest recognizable product); criterion 6 - knowledge for harvesting (from 1: the less knowledge necessary to 8: most knowledge necessary); criterion 7 - tools needed for harvesting (from 1: the least to 8: the more); criterion 8 - complexity of harvesting process (from 1: lowest to 8: highest); criterion 9 - distribution range (from 1: lowest to 8: highest); criterion 10 - market potential (from 1: low to 8: high); criterion 11 - transport from the harvesting point to the storage center (from 1: the most easy to 8: the most complicated); criterion 12 - perishability (from 1: lowest to 8: highest); criterion 13 - "celebrity" of the product on the market (from 1: the least known to 8: the most popular); criterion 14 - biotic threats (from 1: the fewest threats to 8: the most threats); criterion 15 - abiotic threats (from 1: the fewest threats to 8: the most threats); criterion 16 - development of the process of harvesting (from 1: undeveloped to 8: extremely developed). The analyses were obtained using the Expert Choice Desktop software (v. 11.5.1683).

These criteria were used else were to identify the most important grapevine varieties from Hills of Banat, Huși vineyard, Danube Terraces, viticultural center Stefanesti, Calafat, Odobești (Buciumeanu et al., 2020a,b; 2021; Vizitiu et al., 2020; 2021).

Also, having a high a degree of generality, these criteria have been used in the forestry research field (Blaga et al., 2019; Cântar & Dincă, 2019; Ciontu et al., 2018; 2019; Plești et al., 2019; Tudor & Dincă, 2019; Vechiu & Dincă, 2019; Enescu & Dincă, 2020).

RESULTS AND DISCUSSIONS

All grapevine varieties studied are zoned for Drăgășani vineyard, according to Order no. 225/2006.

The AHP alternative ranking (the average of the marks given on each criterion), ensued from experts'judgment, is presented in Table 1.

According to the AHP results, the grapevine varieties with the highest potential for Drăgășani vineyard were: Crâmposie selecționată, Negru de Drăgășani and Azur (Figure 3). These varieties were obtained at Research and Development Station for Viticulture Drăgășani (Figure 4), being certificated in 1972, 1993 and 1984 respectively. Also, Azur variety was patented - Patent no. 96475 – 06/30/1988.

Table 1. AHP alternative ranking

Criterion	Grapevine varieties							
	Negru de Drăgășani	Azur	Crâmposie selecționată	Sauvignon	Pinot Gris	Fetească regală	Pinot Noir	Riesling italian
1	6	1	3	2	8	5	7	4
2	3	1	2	7	6	4	8	5
3	8	5	7	1	4	6	2	3
4	6	8	7	3	4	2	5	1
5	5	8	2	1	7	3	6	4
6	7	6	4	3	5	2	8	1
7	6	8	3	2	5	1	7	4
8	1	7	2	5	6	3	4	8
9	8	1	7	2	4	3	6	5
10	7	1	8	5	6	2	4	3
11	1	2	6	4	7	3	8	5
12	5	8	7	1	2	4	6	3
13	5	1	8	6	7	3	2	3
14	6	8	4	1	7	2	3	5
15	2	8	3	7	6	5	4	1
16	7	4	8	1	3	2	5	6

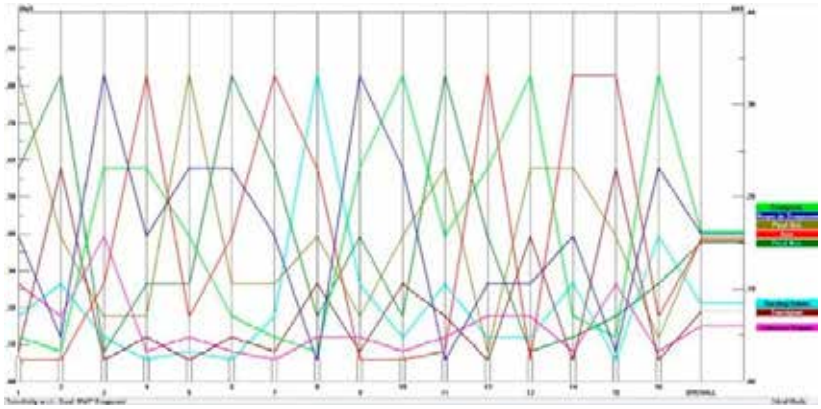

Figure 3. The ranking of the eight grapevine varieties (Negru de Drăgășani, Azur, Pinot Noir, Crâmpoșie, Sauvignon, Pinot Gris, Fetească regală, Riesling italian) cultivated in Drăgășani vineyard

Azur variety is zoned for Drăgășani vineyard only, but it is cultivated in many viticultural centers in the south of the country, and the other two varieties are more widespread. Crâmpoșie selecționată variety can be found in Drăgășani, Dealul Bujorului, Panciu, Sâmburești, Dealurile Craiovei, Murfatlar vineyards. Outside from Drăgășani vineyard, Negru de Drăgășani variety is zoned for the vineyards: Dealu Mare, Ștefănești, Sâmburești, Dealurile Craiovei, Plaiurile Drâncei (Order no. 225/2006). Azur variety exploited very good the climatic and pedological resources of the Iași Vineyard (Filimon et al., 2020).

These genotypes have a high growth vigor, generally show good resistance to stress factors and have high grapes production (Table 2). Therefore, they are very suitable for the ecological conditions of Drăgășani vineyard, being studied over time from a pedoclimatic point of view, the number of phytosanitary treatments being much diminished in the normal years.

These varieties selected in the Drăgășani vineyard can develop the viticulture in Oltenia and in Romania, implicitly, offering local alternatives for wine and table grapes (Gorjan, 2013).

The selected varieties are important sources of valuable genes both for the Drăgășani vineyard and for the other vineyards in Romania and, therefore, recommending their use in the programs of grapevine genetic improvement in Romania and abroad.

Crâmpoșie selecționată

Negru de Drăgășani

Azur

Figure 4. Crâmpoșie selecționată, Negru de Drăgășani and Azur grapevine cultivars (after Măcău and Gorjan, 2016)

Table 2. Behaviour to stress factors and production characteristics of Crâmpoșie selecționată, Negru de Drăgășani and Azur grapevine varieties (adapted after Stroe, 2012; Ampelografia României IX, 2018; https://www.madr.ro/docs/cercetare/Rezultate_activitate_de_cercetare/SCDVV_Dragasani.pdf.)

Grapevine cultivar	Origin	Behaviour to stress factors	Characteristics of the yield
Crâmposie selecționată	Free fecundations of Crâmpoșie cv.	Good resistance to downy mildew, powdery mildew, gray rot and medium tolerance to frost (-22°C…-20°C).	- ripening stage: the 5th; - vegetation period: 190-200 days; - grapes yield: 16.5 t/ha, in average; - bunch: medium to large size (190-250 g); berries: medium size (2.5-2.7 g); - Sugar accumulation in grape berries at full maturity: 186-209 g/l; 186-209 g/l; must acidity: 4.2-4.6 g/l H_2SO4.
Negru de Drăgășani	Negru vârtos x Saperavi	Good resistance to frost (until -22°C), drought, downy mildew, powdery mildew; very good resistance to gray rot.	- ripening stage: the 5th; - vegetation period: 180-206 days; - grapes yield: 11-15t/ha, in average; - bunch: medium size (180-200 g); berries: medium size (2.0-2.5 g); - high potential of sugar accumulation in grape berries (195 -199 g/l); acidity: 4.7‰.
Azur	Coarnă neagră x Cardinal	Good resistance to powdery mildew and downy mildew and poor resistance to gray rot; good resistance to cold and drought.	- ripening stage: the 3rd - 4th; - vegetation period: 175-185 days; - grapes yield: 20.5t/ha, in average; bunch: medium size (250-400 g); berries: medium size (1.80-3.28 g); - sugar accumulation in grape berries at full maturity:154 g/l; acidity: 3.4 g/l H_2SO4.

The rootstocks recommended for Crâmpoșie selecționată, Negru de Drăgășani and Azur varieties are: SO4-4, Berlandieri x Riparia Kobber 5 BB - Crăciunel 2 Selection, Dragasani M-70.

Berlandieri x Riparia Kobber 5 BB - Crăciunel 2 Selection rootstock has a very good resistance to moisture and drought, with a very good vigour. By grafting using this rootstock, a very good percentage of standard grapevines were obtained.

CONCLUSIONS

According to AHP results, based on pairwise comparisons of 16 criteria having a high degree of generality, Crâmpoșie selecționată, Negru de Drăgășani and Azur varieties were selected as the most important grapevine varieties for Drăgășani vineyard, under the conditions in which all eight grapevine varieties taken into the study are zoned for this area. These genotypes generally show good resistance to stress factors and have a high grapes yield.

Although the vineyard assortment consists mainly of wine varieties and to a lesser extent of table grape, the selected varieties are both for wine (Crâmpoșie selecționată, Negru de Drăgășani) and for table grapes (Azur).

Due to the diversity and variability of the ecological conditions, Drăgășani vineyard benefits of favorable eco-climatic conditions for grapevine cultivation and the use of AHP results can contribute to the development of a sustainable viticulture.

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