Corvinus University of Budapest

INVESTIGATION OF THE CULTIVATION VALUE AND THE RELATIONS OF ORIGIN OF OLD GRAPEVINE CULTIVARS IN TOKAJ

Theses of Doctoral Dissertation

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1. INTRODUCTION

Ampelography (knowledge of grapevine cultivars) is an important section of viticulture. Cultivar is considered as one of the primary factors determining the quality and quantity of grapevine.
Because of the large number of cultivars grouping and taxonomy are highly important in ampelography. Recently besides morphological observations mathematical and molecular methods are also available for identifying and determining cultivars or for the development and the correction of subspecific taxonomy.
Study of cultivars is also a significant part of ampelography. Changes in plantation structure and in cultivation technology or the appearance of certain biotic and abiotic stress factors can modify the requirements for cultivars; hereby demand for some cultivars is also influenced.
Indigenous, old grapevine cultivars derive from selection and natural hybridizations. Their present existence and diffusion are the proofs of adaptability and cultivation value. Choice of variety is significantly influenced by tradition. The aim of ampelographic studies is to evaluate old cultivars according to the recent cultivation level.
Wine specialities of Tokaj were traditionally made from the vintage of several cultivars. Assortment of varieties from the 16th to the 19th century can be hardly estimated attributable because to the large number of synonyms and mixed plantations. Mainly because of the individuals with higher quantity and worse quality – multi-cultivared vineyards were considered disadvantageous already in the 19th century. The assortment based on ‘Furmint’, ‘Hárslevelű’ and ‘Sárga muskotály’ (synonym of ‘Muscat lunel’) has fixed after the disaster of phylloxera. Several old representatives of Tokaj can be found only in grapevine collections. In the recent years range of recommended and permitted cultivars has slightly expanded. Nowadays extending the assortment of cultivars in the wine region can be one resource of quality-development.

2. MATERIAL AND METHODS

In my doctoral thesis ten old grapevine cultivars of Tokaj ('Balafánt', 'Budai gohér', 'Juhfark', 'Kövérszőlő', 'Purcsin', 'Sárga ortlibi', 'Török gohér', with 'Fehér (white) furmint', 'Piros (red) furmint' and 'Változó (altering) furmint') were evaluated regarding cultivation value and relationship. '*Balafánt'* has presumably originated from Tokaj (MOLNÁR, 1897), its name can be found in lists of cultivars already in the 18th century (BALASSA, 1991). The detailed description of '*Budai gohér'*, as an individual cultivar, doesn't occur in the accessible ampelographic studies. KELETI (1875) mentions it as a synonym of 'Juhfark', besides NÉMETH (1970) refers to it as a synonym of 'Fehér gohér' and 'Demjén'. '*Juhfark'* has appeared in the notices of the wine region since the 19th century. Its qualitative estimation is variable, mostly unfavourable. According to BALASSA (1991) '*Kövérszőlő'* (a. k. a. 'Grasa de Cotnar') is identical with „Fejérszőlő" which frequently occurs in the lists of cultivars in Tokaj. The blue-berried '*Purcsin'* is considered as either an old autochthon of Hungary (CSEPREGI-ZILAI, 1955) or the descendant of Tokaj (GÖRÖG, 1829; LÉGRÁDY, 1844). '*Sárga ortlibi'* (a. k. a. 'Kniperlé') has originated from Alsace (MOLNÁR, 1897). Probably its susceptibility to noble rot has resulted it getting to the Tokaj wine region. The investigated '*Török gohér'* is identical with the white-berried member of the 'Gohér' conculta (group of cultivars). It is one of our oldest grown grapevine cultivars, large number of its synonyms also refers to it (HEGEDÜS et al., 1966). The white-berried member of '*Furmint' conculta* (group of cultivars) is still the primary cultivar of the Tokaj wine region, while Piros (red) furmint' and 'Változó (altering) furmint' can be found only in grapevine collections.

The place of my studies was one of the prime sites of the Tokaj wine region (Mandolás dűlő), the investigated plot belongs to the Tokaj-Oremus Ltd. The experiments were carried out from 2004 to 2006. The investigated parcel, namely 100-100 vines per cultivar, is part of a royat-cordon trained vineyard, which were planted in 1997.

Besides the vegetative and generative performance microvinificational samples of the investigated cultivars were also evaluated. In 2005-2006 the examined vines were morphologically described with the application of the code numbers of the OIV. Measurable features of

the seeds were additionally recorded. Cultivars were also characterised with SSR-analysis. Registered data were evaluated with several mathematical methods to be able to separate and identify cultivars, besides detecting similarity groups and relationships.

3. RESULTS AND DISCUSSION

3.1. Morphological Description of the Investigated Cultivars Based on the O.I.V. Code Numbers

Out from 91 recorded morphological features 16 characteristics were identical in case of every investigated cultivar. Only 47 code numbers of the ‘Furmint’ conculta-members were equal. ‘Budai gohér’ and ‘Török gohér’ separated in 25 features. According to the morphological characteristics it can be claimed, ‘Budai gohér’ is not a member of the ‘Gohér’ conculta. The investigated ‘Budai gohér’ is identical with the cultivar ‘Demjén’ which can be found in the grapevine collection of Pécs.

In 2005-2006 there was 6-10 days difference in the time of bud burst in case of the investigated cultivars. Comparing the cultivars smaller differences were found regarding the times of full flowering, veràsion and ripening of shoot. In the years of my experiments there were 27 and 38 days variance concerning the time of full maturity. In case of ‘Furmint’ conculta every phenological stage occurred with only 1-2 days difference. Stages of ‘Budai gohér’ and ‘Török gohér’ moved on simultaneously.

In 2006 bunch stem necrosis damaged the clusters of ‘Török gohér’ and ‘Juhfark’. The smallest failure of the fruit was registered in case of ‘Budai gohér’ and the ‘Furmint’ conculta.

Development of secondary shoots is weak regarding ‘Balafánt’, ‘Sárga ortlibi’ and ‘Piros furmint’; that of ‘Fehér furmint’ and ‘Változó furmint’ is medium-strong; while ‘Budai gohér’, ‘Török gohér’, ‘Kövérszőlő’ and ‘Purcsin’ have vigorous secondary shoots.

3.2. Vegetative and Generative Performance

Phytotechnical indices were influenced by the vintages and shoot-thinning. ‘Budai gohér’ and ‘Török gohér’ could be separated with several values (such as: absolute fertility index, fertility of different buds). Indices of ‘Balafánt’ and ‘Budai gohér’ were equal except the number of shoots, bunches and fertile shoots. In most cases ‘Kövérszőlő’ showed similarity with the investigated western cultivars (‘Purcsin’ and ‘Sárga ortlibi’). Regarding the phytotechnical indices mainly the altering-berried member of the ‘Furmint’ conculta separated. According to NEGRUL’ (1946) representatives of the proles orientalis (eastern cultivars) raise less shoots and bunches. My investigations have not confirmed it in case of ‘Juhfark’.

In 2005-2006 ‘Budai gohér’, ‘Kövérszőlő’, ‘Purcsin’, ‘Fehér furmint’ and ‘Változó furmint’ were vigorous, while ‘Balafánt’, ‘Juhfark’, ‘Sárga ortlibi’, ‘Török gohér’ and ‘Piros furmint’ had weaker shoot growth.

Most of the investigated cultivars have erecting shoots. Only the shoot-position of ‘Balafánt’ and ‘Juhfark’ are semi-erecting. All these cultivars are perfectly suitable for the royat-cordon training system. On the other hand ‘Kövérszőlő’ has sprawling shoots, which highly increase the demand of the cultivar for phytotechnical treatments in the period of intensive shoot growth.

Based on the results of three vintages the productivity of ‘Balafánt’, ‘Fehér furmint’ and ‘Változó furmint’ is the largest; while ‘Juhfark’, ‘Kövérszőlő’ and ‘Sárga ortlibi’ yields the least.

In 2004-2006 juice of ‘Juhfark’ had the highest sugar content, while ‘Piros furmint’ reached the lowest values. Titrable acid content of ‘Juhfark’ was steadily high in every vintage.

In 2004 ratio of sound berries was the lowest, more or less every investigated cultivar was damaged by Botrytis. In case of ‘Budai gohér’, ‘Juhfark’, ‘Sárga ortlibi’, ‘Török gohér’ and ‘Fehér furmint’ it resulted in considerable noble rot. In 2005 the fruit of ‘Purcsin’, ‘Török gohér’ and ’Piros furmint’ mostly remained sound. The berries of ‘Balafánt’, ‘Fehér furmint’ and ‘Változó furmint’ were significantly infected by Botrytis (> 20 %). Besides ‘Juhfark’, ‘Kövérszőlő’, ‘Sárga ortlibi’, ‘Fehér furmint’ and ‘Változó furmint’ noble rotted also. Ratio of sound berries was the highest in 2006. Damage of Botrytis hasn’t

surpassed 20 % in case of neither cultivar. However ‘Juhfark’, ‘Sárga ortlibi’ and ‘Változó furmint’ noble rotted to a smaller degree.
In case of five cultivars two-sample analysis was carried out on the composition of the berries developed from different fertilization, besides the correlation between the size and the content of the berry was measured in 2004-2005. My results showed there’s no significant correlation between the size (conditions of fertilization) and the composition of the berry.

3.3. Wine Quality

The average alcoholic content of the microvinificational wines was the highest in 2004. The values of ‘Budai gohér’, ‘Juhfark’ and ‘Sárga ortlibi’ surpassed 14 V/V%, while the content of ‘Purcsin’ and ‘Piros furmint’ was smaller than 11 percentages. In the wines of ‘Balafánt’ and ‘Juhfark’ significant amount of sugar remained, while the other samples totally fermented out. In 2005 alcoholic content of ‘Juhfark’ surpassed 15 V/V%, while the value of ‘Piros furmint’ remained under 10 V/V%. Significant amount of sugar (> 5 g/l) was not measured in either sample. In 2006 alcoholic content of ‘Budai gohér’ and ‘Juhfark’ surpassed 13 V/V%, while the value of ‘Balafánt’ was lower than 11 percentages. Considerable amount of sugar remained unfermented (> 20 g/l) in several samples (‘Juhfark’, ‘Kövérszőlő’, ‘Török gohér’, ‘Fehér furmint’ and ‘Változó furmint’).

3.4. Investigation of the Relations of Origin

Mathematical analysis of the code numbers from the transformation of morphological features is suitable for taxonomic observations. Discriminant analysis carried out on the characteristics of the investigated cultivars and the extended list confirmed the classification of “natural” taxonomic system. The cluster analysis of the investigated cultivars described with the OIV (1997) code numbers and the cluster analysis of the morphological characteristics of the extended list were both suitable for the separation of subspecific taxa. In case of the analysis of OIV (1997) code numbers the investigated pontican cultivars (‘Balafánt’, ‘Budai gohér’ and ‘Furmint’ conculta) formed a similarity group. Inside convarietas

pontica the representative of the other subconvarietas, namely ‘Kövérszőlő’ clearly separated. Western (‘Purcsin’ and ‘Sárga ortlibi’) and eastern (‘Juhfark’) cultivars formed one cluster. In case of the analysis of the extended list convarietas pontica and convarietas orientalis formed two separated similarity groups. While representatives of the convarietas occidentalis occurred in both clusters.

Features measured on the seeds of grapevine cultivars are proper for several evaluations. One-Way ANOVA of the original parameters and the averages categorized with different descriptors and ampelographies were able to separate cultivars. While cluster and discriminant analyses of the averages were suitable for taxonomic observations and detection of relationships.

My microsatellite investigations disclaimed the supposed parent-offspring connection between ’Pinot noir’ and ’Sárga ortlibi’. While close relationship of ’Pinot noir’ and ’Chardonnay’ was confirmed. Members of ‘Furmint’ conculta (’Fehér furmint’, ’Piros furmint’ and ’Változó furmint’) could not be distinguished with the six primers. The “blindly-collected” ‘Loose-bunched furmint’ differed only in the homozygosity detected on the locus VrZag62. Variance in the genotypes of the two ‘Gohér’ cultivars (’Budai gohér’ and ’Török gohér’) disclaimed the close relationship of the samples.

Cluster analysis of the results converted to binary scale gave the taxonomically most proper dendrogram.

4. NEW SCIENTIFIC ACHIEVEMENTS

1. Morphological and molecular examinations, besides the mathematical analysis of the results proved that *'Budai gohér' vines of the investigated plot is not a member of the Gohér conculta*. In this case „Gohér" is only a collective noun for old female-flowered cultivars of Tokaj. Vegetative and generative performance of 'Budai gohér' and 'Török gohér' were also different. 'Budai gohér' and 'Török gohér' could be separated with certain phytotechnical indices (total number of shoots, ratio of fertile shoots, number of shoots with one or two buds, absolute fertility index, fertility of different buds). Susceptibility to bunch stem necrosis (2006); vigour and the ratio of different-sized berries were also significantly different.
2. *The investigated 'Budai gohér' separated from the 'Demjén' vines of Tarcal* with morphological and molecular methods. While it was proved to be *identical with the 'Demjén' representatives in the grapevine collection of Pécs.*
3. Over the attributes pointed out by NÉMETH (1967) *representatives of the Furmint conculta were different in several other morphological and cultivation characteristic*s. The investigated three cultivars were identical only in 47 code numbers from 91 morphological features. 'Piros furmint' separated from the other two conculta-members with weaker shoot growth, lower sugar content and acidity of the juice, lack of susceptibility to noble rot; i. e. the red-berried Furmint had the worst vegetative and generative performance inside the conculta.
4. *There is no unequivocal, significant difference among the composition* (sugar and acid content, pH) *of berries developed from different fertilization.* In case of five cultivars one-way comparison was carried out on the composition of the berries developed from different fertilization, and correlation analysis was done between the distribution and the content of berries. My results showed there's no significant correlation between the size (conditions of fertilization) and the composition of the berry.
5. Mathematical analysis of the code numbers from the transformation of morphological features is suitable for taxonomic observations. Discriminant analysis carried out on the

characteristics of the investigated cultivars and the extended list confirmed the classification of "natural" taxonomic system. *The cluster analysis of the investigated cultivars described with the OIV (1997) code numbers and the cluster analysis of the morphological characteristics of the extended list were both suitable for the separation of subspecific taxa.* In case of the analysis of OIV (1997) code numbers the investigated pontican cultivars ('Balafánt', 'Budai gohér' and 'Furmint' conculta) formed a similarity group. Inside convarietas pontica the representative of the other subconvarietas, namely 'Kövérszőlő' clearly separated. Western ('Purcsin' and 'Sárga ortlibi') and eastern ('Juhfark') cultivars formed one cluster. In case of the analysis of the extended list convarietas pontica and convarietas orientalis formed two separated similarity groups. While representatives of the convarietas occidentalis occurred in both clusters.

6. Features measured on the seeds of grapevine cultivars are proper for several evaluations. *One-Way ANOVA of the original parameters and the averages categorized with different descriptors and ampelographies were able to separate cultivars. While cluster and discriminant analysis of the averages were suitable for taxonomic observations and detection of relationships.*
7. My microsatellite investigations *disclaimed the supposed parent-offspring connection between 'Pinot noir' and 'Sárga ortlibi'* based on the fragment length of VvS2, VVMD5 és VrZag79 primer pairs. While close relationship of 'Pinot noir' and 'Chardonnay' was confirmed.
8. Mathematical analysis of the molecular genetic data pointed out that cluster analysis of the fragment length results converted to binary scale gave the taxonomically most proper dendrogram. Examination showed clearly the similarity of the genotypes of the investigated cultivars.

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