AMPELOGRAPHIC CHARACTERIZATION OF TURKISH INDIGENOUS GRAPE ACCESSIONS AND EUROPEAN CULTIVARS

(*Vitis vinifera* L.)

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A total of 35 grape accessions and 3 reference cultivars were used to investigate the genetic polymorphism and relationships among Turkey and other European grape accessions by ampelographic characterization. Total of 74 ampelographic characteristics were identified for 38 genotypes. Ampelographic data were collected two vegetation periods. The characteristics of the vines were defined and measured according to OIV descriptors. In this study, three synonym varieties (100% similarity) were identified: 'Cabernet Sauvignon' and 'Cabernet Franch'; standard grape variety 'Merlot' and no.12 genotype (Merlot), and 'Sèmillion' analyzed as a standard grape variety and no. 1 'Sèmillion' genotype. Based on similarity rate of grape varieties, highest similarity ratios were found between 'Yuvarlak Razakı-Siyah Gemre' with 93%, 'Yuvarlak Razakı-Siyah Gemre' and 'Şika' with 91%, 'Moiseylative-Hafızali' with 90% and 'Kırmızı Şam-Pembe Gemre' genotypes with 89%. In principal component analyses graph, 'Müşküle', 'Buca Razakı', 'Moiseylative', 'Kırmızı Şam', 'Cardinal', 'Yuvarlak Razakı', 'Hafızali', 'Siyah Gemre' and 'Şika' were grouped together.

**Keywords:** *Vitis vinifera* L., Ampelography, Characterization, Grape Accessions

INTRODUCTION

Anatolia has a long history of viticulture and a wide diversity of grape cultivars. Grapevines (*Vitis vinifera* L.) are one of the oldest domesticated crop plants and economically the most important cultivated fruit crops in the world. Turkey, one of the countries where *Vitis vinifera* L. was first cultivated, has a rich grapevine gene potential. According to Oraman and Ağaoğlu, 1969 [1], Turkey has a history of viticulture dating back to 3500 B.C. Grapes have an important place among agricultural products as table grapes, wine grapes, raisin and with their various local uses.

Ampelographic studies have been undertaken for many years to present the grapevine gene potential in Turkey. As in many parts of the world, heterozygotic hereditary structure of the grapevine has resulted in the generation of a wide variety, type and species in Turkey, a country regarded as the homeland of viticulture for *Vitis vinifera* L. Investigation of genetic relationship is very import for germplasm conservation, evaluation and utilization for future grape breeding programs considering the present need of cultivar improvement. The objectives of the present study are to investigate the genetic relationships among Turkey grape accessions which include main local grape varieties in Turkey and some European cultivars were investigated for ampelographic observations of a total of 38 grape accessions (*Vitis vinifera* L.) including the 35 grape accessions and 3 reference cultivars. Scientific studies undertaken to identify the grapevine gene potential in Turkey and to prepare a catalog for this potential to validate it in international contexts are crucial.
MATERIALS AND METHODS

Plant Material
Thirty five grapevine cultivars (Vitis vinifera L.) were analyzed to determine their ampelographic relationships. The representative vines of cultivars were grown in implementation area at Horticulture Department, Agriculture Faculty, Ege University. The locations of the vineyards: 38°27‘32” N, 27°13‘21” E. Nine vines per cultivar were selected for study. The vines were 12 years old and cultivated under the same growing conditions using rootstock 41B (V. vinifera x Berlandieri) with the spaces 2,5 x 3 m.

Three reference cultivars, Vitis vinifera L. cv. 'Cabernet Sauvignon', Vitis vinifera L. cv. 'Merlot' and Vitis vinifera L. cv. 'Sémillon' were considered as reference cultivars, as they were recently characterized in detail using SSR primers of core set, VVS2, VVMD5, VVMD7, VVMD27, VrZAG62 and VrZAG79 [2], they were grown at Manisa Viticulture Research and implementation area (Manisa/Turkey). Basic ampelographic characteristics of grape varieties and reference cultivars used in this study is listed in Table 1.

Ampelografic Evaluation
Ampelographic characterization of 38 grapevine genotypes was conducted using the descriptions in the Descriptors for Grapevine (Vitis spp.) (GENRES 081 1997) and the Office International de la Vigne et du Vin (OIV) Descriptor List for Grape Varieties and Vitis species [3, 4]. Descriptors used in this study and their OIV-IPGRI codes are presented in Table 2. In total, 75 different descriptors were used.

Ampelographic observations were carried out during two consecutive vegetation periods. The characteristics of the vines were defined and measured according to OIV descriptors. The characters of representing vines were investigated/measured following the specifications of vine growth stages indicated by OIV. The shoot tips were investigated when they were approximately 10 to 30 cm in height, and the first four distal leaves of young leaves were evaluated.

Mature leaf descriptions were obtained between berry set and beginning of berry maturity and were conducted on leaves above the cluster within the middle of the shoot. The clusters were measured at maturity and berry characteristics were obtained from ripe berries located in the middle of the bunch.

On average, ten canes per variety were analyzed after leaf fall. The mean values obtained over two years were transformed to numerical scales according to international descriptors. The resulting raw data were analyzed in NTSYSpc 2.0 software [5] using a distance matrix. The clustering dendrogram was based on the unweighted pair group of the arithmetic mean (UPGMA) [3]. A principal component analysis (PCA) graph was also constructed.

Ampelografic Analysis Evaluation
For analysis, dendrograms for genotypes according to UPGMA (Unweighted pair-group method arithmetic average) grouping were obtained by using NTSYS-version 2.0 (Numerical Taxonomy and Multivariate Analysis System) [5] statistical package program.

RESULTS AND DISCUSSION
Ampelographic studies are utilized to identify existing and new breeds in all the countries where viticulture is common. Identification of the ampelografic characteristics of grapevine accessions and varieties is crucial for identification and classification. It is important to know grape accession qualities to determine the best adapted varieties and to plan breeding work. In this study, ampelografic observations were carried out by investigating 73 features in 38 grape accessions based on “Descriptors for Grape”.

According to ampelografic observation results presented in Table 2, all grape accessions in the study were identified as Vitis vinifera L. since their shoot types (OIV 001) were “open=7” and sequencing of tendrils (OIV 16) were “discontinuous=1” i.e. “2 or less”.

Density of anthocyan on the tip of shoots (OIV 003) was not observed in 'Müşküle', 'Moiselaylave', 'Pek Üzümü', 'Italia', 'Siyah Gemre', 'Colombard', 'Abiguş' and 'Kırımızı Şam' grape varieties (0=absent), it was found to be medium in 'Cabernet Sauvignon' and 'Cabernet Franc' Şam' grape varieties (5=medium) and it was weak (3=weak) in other grape varieties.

Examination of OIV 244 descriptor (seed: tranversal ridges on side) shows that lack of tranversal ridges on side (absent=0) validates the variety as belonging to Vitis vinifera L.
Examination of flower types (OIV 151) shows that all grape accesses had hermaphrodite (hermaphrodite=3) structure.

It is very important to examine mature leaf characteristics in ampelographic definitions. Based on “Mature leaf: number of lobes” (OIV 068) descriptor, ‘Yuvarlak Razakı’ and ‘Çeşme Pembesi’ grape varieties were found to have 3 lobes “three=2” while the others had five lobes five=3” (Table 2). Definitions relevant to mature leaves have been generally approved as powerful way of identifying grapevine genotypes [6, 7]. In a similar studies, Ecevit and Kelen 1999, [8] and Ateş et al., 2011 [9] also reported the leaves with five lobes as a major type among some Turkish grapes.

All grape accesses in this study were determined to be “both sides convex=3” based on mature leaf: shape of petiole sinus (OIV 079) descriptor. Differences were observed between varieties in terms of “Mature leaf: length” (OIV 066) and “mature leaf: shape of base of petiole sinus” (OIV 080) descriptors. ‘Tarsus Pembesi’ and ‘Granache’ varieties were in “short=3” group in terms of leaf size whereas other varieties were in “very short=1” group.

According to “Mature leaf: general shape of petiole sinus” (OIV 079) descriptor, ‘İtalia’, 'Sémillon' and 'Çeşme Pembesi' grape varieties were found to be “wide open=2” and the others were identified to be “open=3”.

Differences were identified among grape accesses in terms of cluster characteristics. Three separate groups were identified among the varieties with “Bunch: length” (OIV 203) descriptor. The majority of the grape varieties were included in “very short (< 11 cm)” classification group while 'Kırmızı Şam' and 'Moiseylative' varieties were in “long (24-26 cm)” group. ‘Öküzgözü’, ‘Kozak Gemresi’, ‘Çeşme Pembesi’, ‘Cardinal’, ‘Ohannes’, ‘Siyah Gemre’ and ‘Yuvarlak Razakı’ grape varieties were in “short (14-16 cm)” group. As stated by Marasali, 1986 [10] and Demir, 1987 [11], cluster lengths can differ based on whether the variety is situated in its own ecology or its adaptation to the ecology it is situated in.

Evaluation of results obtained from “Berry: uniformity of size” (OIV 222) descriptor shows differences among varieties and it was found that berries were generally uniform in clusters.

According to “Berry: shape” based on OIV 223 descriptor: The majority of the grape varieties were found to have round, while 'Şika' and 'Çeşme Pembesi' ovate, 'Delbele' obovate, 'Öküzgözü', 'Sémillon' and 'Alicante Boushet' slightly flat, 'Pek Üzümü', 'Hafızalı', 'Conlonbart' and 'Moiseylative' obtuse-ovate, 'Cinsaut' and 'Buca Razakısı' were found to have long eliptic shape.

In terms of “Berry: classification of flavor” (OIV 237) descriptor, 'Cardinal', 'Merlot' and 'Harsleleh' grape varieties were found to have unique flavors and were included in “little flavor=2” classification group.

The UPGMA dendrogram, constructed on the basis of ampelographic scoring (0 to 9) using a distance matrix, is shown in Figure 1. Average similarity ratio of genotypes is 84%. Genotypes have shown various types of branching in ampelographic dendrogram. In the first differentiation of the dendrogram, 'Abiğuş grape cultivar generated a different group from other varieties. In the second differentiation of the dendrogram, 'Öküzgözü', 'Grenache Noir', 'İtalia', 'Kozak Gemresi', 'Kırmızı Şam', 'Pembe Gemre', 'Yuvarlak Razakı', 'Siyah Gemre', 'Şika', 'Cardinal', 'Moiseylative', 'Hafızalı', 'Buca Razakı', 'Pek Üzümü', 'Çeşme Pembesi', 'Mahrabaşı', 'Tarsus Pembesi', 'Beyaz Şam', 'Ohannes', 'Müşküle' genotypes created sub groups and were distributed along the dendrogram. In the third differentiation point, some groups of two or three were found to be generated from the three reference varieties and 14 genotypes.

As can be seen in the dendrogram, three synonym varieties (100% similarity) were identified: 'Cabernet' and 'Cabernet Franch', standard grape variety 'Merlot' and no.12 genotype (Merlot) and 'Sémillion' analyzed as a standard grape variety and no. 1 'Sémillion' genotype.

Based on similarity rate of grape varieties, highest similarity ratios were found between 'Yuvarlak Razaki-Siyah Gemre' with 93%, 'Yuvarlak Razaki-Siyah Gemre' and 'Şika' with 91%, 'Moiseylative-Hafızalı' with 90% and 'Kırmızı Şam-Pembe Gemre' genotypes with 89%. As seen in principal component analyses graph, 'Müşküle', 'Buca Razakı', 'Moiseylative', 'Kırmızı Şam', 'Cardinal', 'Yuvarlak Razakı', 'Hafızalı', 'Siyah Gemre' and 'Şika' were grouped together. No links were found with being local or universal varieties (Figure 1, Figure 2).

Prevalence of homonym and synonym groups were also presented in studies implemented with Turkish grape accesses [12, 13, 14, 15, 16, 17, 18, 19, 20, 21]. Development of viticulture in
Turkey will be possible when scientific studies that will allow the identification and preservation of our rich grapevine gene potential and provide resources for new breeding studies will be given the required importance. It is imperative to test the ampelographic characteristics of grape varieties and their relationships at genetic levels through modern methods that have international levels of reliability in order to conserve grape varieties in Turkey and select high quality varieties from among them. It is crucial to identify the genotypes via exact identification since some genotypes are names the same. In addition, the present study provided particular knowledge on some autochthonous grapevine cultivars, most of which are today on the verge of extinction. This study would therefore help to prevent disappearing local cultivars and to preserve such germplasm collection for the future studies. It is hoped that this study will enlighten similar studies in the field in the future.

ACKNOWLEDGMENTS

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REFERENCES


Table 1. Basic ampelographic characteristics of the grape cultivars used in this study.

<table>
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<tr>
<th>Cultivar</th>
<th>Cluster Form</th>
<th>Berry Form</th>
<th>Berry Colour</th>
<th>Flavor</th>
<th>Seed</th>
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<td>Cabernet Sauvignon</td>
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<td>Present</td>
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<tr>
<td>Merlot</td>
<td>Very dense</td>
<td>Round</td>
<td>Blue-black</td>
<td>Little aromatic</td>
<td>Present</td>
</tr>
<tr>
<td>Semillon</td>
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</tr>
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<td>Grenache Noir</td>
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<td>Round</td>
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<td>Present</td>
</tr>
<tr>
<td>Cabernet Fanco</td>
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<td>Present</td>
</tr>
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<td>Papazkarası</td>
<td>Very dense</td>
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<td>Blue-black</td>
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<td>Present</td>
</tr>
<tr>
<td>Oküzgözü</td>
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<td>Slightly flat</td>
<td>Rose</td>
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</tr>
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<td>Petit Syrah</td>
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<td>Merlot</td>
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<td>Blue-black</td>
<td>Little aromatic</td>
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</tr>
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<td>Alicante Bouschet</td>
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<td>Dolbele</td>
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<td>Present</td>
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<tr>
<td>Grenache</td>
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<td>Little flavour</td>
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</tr>
<tr>
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<td>Present</td>
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<td>Ovate</td>
<td>Rose</td>
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<td>Present</td>
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<td>Present</td>
</tr>
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<td>Abigüj</td>
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<td>Round</td>
<td>Red</td>
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<td>Present</td>
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<td>Kırkızı Şam</td>
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<td>Mahraşışy</td>
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<td>Pembe Gemre</td>
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<tr>
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Table 2. Ampelographic characteristics of grape cultivars used in this study.

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Table 2. Ampelographic characteristics of grape cultivars used in this study (continued).

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G with r.s: Green with red stripes; Dis. cont.: Discontinuous (2 or less); Sub. or cont.: Subcontinuous or continuous (3 or more); Green with b.s.: Green with bronze spots; B. s. straight: Both sides straight; O. s. c, o. s. c.: One side concave, one side convex; L. s. overlap.: Lobes slightly overlapping. Tarsus Pembesi*; Cabernet Franc*; Abiguş*; Cabernet Sauvignon*; Beyaz Şam*; Pembe Gemre*; Mahraşi*; Granache Noir*. Grape varieties that could not be observed in their maturity due to lack of sufficient number of clusters that could be analyzed.
Figure 1. Dendrogram showing the relationships of 38 grapevine cultivars used in this study based on UPGMA cluster analysis of 73 features in “Descriptors for Grape”

Figure 2. Principal component analyses of 38 grapevine cultivars used in this study based on 73 ampelographic characteristics