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AMPELOGRAPHIC CHARACTERIZATION OF TURKISH INDIGENOUS GRAPE ACCESSIONS AND EUROPEAN CULTIVARS (*Vitis vinifera* L.)

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ABSTRACT

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

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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: $38^{0}27'32''$ N, $27^{0}13'21''$ 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 (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 un-weighted 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

Ampelografic 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', 'Moiseylative', 'Pek Üzümü', 'İtalia', 'Siyah Gemre', 'Colombard', 'Abiguş' and 'Kırmızı 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 of the seed (absent=0) validates the variety as belonging to *Vitis vinifera* L.

Examination of flower types (OIV 151) shows that all grape acccessions had hermaphrodite (hermaphrodite=3) structure.

It is very important to examine mature leaf characteristics in ampelografic 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 accessions in this study were determined to be “both sides convex=3” based on mature leaf: shape of teeth (OIV 076) 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 accessions 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', 'Hafızali', '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, 'Abiguş' grape cultivar generated a different group from other varieties. In the second differentiation of the dendrogram, 'Öküzgözü', 'Grenache Noir', 'Italia', 'Kozak Gemresi', 'Kırmızı Şam', 'Pembe Gemre', 'Yuvarlak Razakı', 'Siyah Gemre', 'Şika', 'Cardinal', 'Moiseylative', 'Hafızali', '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 '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%. As seen in principal component analyses graph, 'Müşküle', 'Buca Razakı', 'Moiseylative', 'Kırmızı Şam', 'Cardinal', 'Yuvarlak Razakı', 'Hafızali', '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 accessions [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.

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REFERENCES

[1] Oraman, MN. and Agaoglu, YS. (1969). Some characteristics of Turkey's viticulture and the composition of its districts in viticulture. Ankara University Agriculture Faculty Yearbook, Ankara.

[2] İşçi, B. and Dilli, Y. (2014). Ege Bölgesi Yerel Asma Çeşitlerinin (Vitis vinifera L.) basit tekrar dizileri (SSRs) ile karakterizasyonu. Tarım Bilimleri Dergisi, 21 (4), 538-545.

[3] OIV (2001). Second Edition of the OIV Descriptor list for grape varieties and Vitis Species Website: http://www.oiv.int

[4] Anonymous (2013). GENRES - Informationssystem Genetische Ressourcen, http://www.genres.de/vitis/

[5] Rohlf, F.J. (2000). Phylogenetic models and reticulations. J. Classif., 17, 185-189.

[6] Ortiz, J. M., Martin, J. P. Borrego,J. Chavez, J. Rodriguez, I. Munoz, G. and Cabello, F. (2004). Molecular and morphological characterization of a Vitis gene bank for the establishment of a base collection. Genetic Research and Crop Evaluation, 51: 403-409.

[7] Santiago, J. L., Boso, S. Gago, P. Alonso-Villaverde, V. and Martinez, M.C. (2007). Molecular and ampelographic characterization of Vitis vinifera L. 'Albarino', 'Savagnin Blanc' and 'Caino Blanco' shows that they are different cultivars. Spanish Journal of Agricultural Research, 5: 333-340.

[8] Ecevit, F. M. and Kelen, M. (1999). Determination of ampelographical characters of grape cultivars grown in Isparta (Atabey). Turkish Journal of Agriculture and Forestry, 23: 511-518.

[9] Ateş, F. Çoban, H. Kara, Z. and Sabır, A. (2011). Ampelographic characterization of some grape cultivars (Vitis vinifera L.) grown in South-western region of Turkey. Bulgarian Journal of Agricultural Science, 17 (3), 314-324.

[10] Marasalı, B. (1986). Determination of the ampelographic characters of some native standard grape varieties grown in Ankara conditions. Master Thesis, Ankara University. Graduate School of Natural and Sciences, Ankara.

[11] Demir, I. (1987). Studies on identification of ampelographic characteristics of foreign origin grape varieties cultivated in Ankara. Master Thesis, Ankara University. Graduate School of Natural and Sciences, Ankara.

[12] Ergül, A., Kazan, K., Aras, S., Çevik, V., Çelik, H. and Söylemezoğlu, G. (2006). AFLP analysis of genetic variation within the two economically important Anatolian grapevine (Vitis vinifera L.) varietal groups. Genoma, 49: 467-475.

[13] Karaağaç, E. (2006). Molecular analysis of Gaziantep province grapevine gene potential through SSR Markers. Doctora Thesis, Ankara University. Graduate School of Natural and Sciences, Ankara.

[14] Vouillamoz, J.F., Mcgovern, P.E., Ergül, A., Soylemezoglu, G., Tevzadze, G., Meredıth, C.P. and Grando, M.S. (2006). Genetic characterization and relationships of traditional grape cultivars from Transcaucasia and Anatolia. Plant Genetic Resources: Characterization & Utilization, 4(2), 144-158.

[15] Selli, F., M. Bakır, G. İnan, H. Aygün, Y. Boz, A. S. Yaşasın, C. Ozer, B. Akman, Soylemezoğlu, G., Kazan, K. and Ergül, A. (2007). Simple Sequence Repeat-Based assesment of genetic diversity in "Dimrit" and "Gemre" grapevine accessions from Turkey. Vitis, 46(4), 182-187.

[16] Yıldırım, N. (2008). Characterization of Kara (Grape) Groups based on SSR(Simple Sequence Repeat) markers and genetic relations of these cultivars and national grapevine Germplasms. Thesis, Ankara

Üniversity, Biotechnology Enstitues.

[17] Shıdfar, M. (2008). Genetic characterization of Eskisehir and Kayseri province grapevine gene sources based on SSRs (Simple Sequence Repeats). Master Thesis, Ankara University. Graduate School of Natural and Sciences, Ankara.

[18] Hizarcı, Y., Ercişli, S., Yüksel, C. and Ergül, A. (2012). Genetic characterization and relatedness among autochthonous grapevine cultivars from Northeast Turkey by Simple Sequence Repeats (SSR). Journal of Applied Botany and Food Quality, 85, 224 – 228.

[19] Dangl, G.S., Mendum, M.L., Prins, B.H., Walker, A.M., Meredith, C.P. and Simon C.J. (2001). Simple sequence repeat analysis of a clonally propagated species: A tool for managing a grape germplasm collection. Genome, 44, 432-438.

[20] Martın, J.P., Borrego, J., Cabello, F. and Ortız, J.M. (2003). Characterization of the Spanish diversity grapevine cultivars using sequence-tagged microsatellite site markers. Genome, 46, 1-9.

[21] This, P., Jung, A., Boccaccı, P., Borrego, J., Botta, R., Costantını, L., Crespan, M., Dangl, G.S., Eısenheld, C., Ferreıra Monteıro, F., Grando, M.S., Ibanez, J., Lacombe, T., Laucou, V., Magalhaes, N., Meredıth, C.P., Mılanı, N., Peterlunger, E., Regner, F., Zulını, L. and Maul, E. (2004). Development of a standard set of microsatellite reference alleles for identification of grape cultivars. Theoretical and Applied Genetics, 109, 1448–1458.

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

Cultivar	Cluster Form	Berry Form	Berry Colour	Flavor	Seed
CabernetSauvignon	Very dense	Round	Blue-black	Little flavour	Present
Merlot	Very dense	Round	Blue-black	Little aromatic	Present
Sémillon	Dense	Round	Green-yellow	Neutral	Present
Sémillon	Dense	Round	Green-yellow	Neutral	Present
Marsleleh	Dense	Long elliptic	Dark red-violet	Neutral	Present
Conlonbart	Medium	Obtuse-ovate	Green-yellow	Neutral	Present
Grenache Noir	Dense	Round	Dark red-violet	Neutral	Present
Cinsaut	Dense	Long elliptic	Blue-black	Neutral	Present
Cabernet Franc	Dense	Round	Blue-black	Neutral	Present
CabernetSauvignon	Very dense	Round	Blue-black	Little flavour	Present
Papazkarası	Very dense	Round	Red	Little flavour	Absent
Öküzgözü	Loose	Slightly flat	Rose	Little flavour	Present
Petit Syrah	Dense	Round	Blue-black	Neutral	Present
Foça Karası	Very dense	Round	Blue-black	Neutral	Present
Merlot	Very dense	Round	Blue-black	Little aromatic	Present
Alicante Boushet	Very dense	Slightly flat	Blue-black	Little flavour	Present
Delbele	Medium	Obovate	Blue-black	Neutral	Present
Grenache	Medium	Round	Blue-black	Little flavour	Present
Malbee	Dense	Round	Blue-black	Neutral	Present
Çeşme Pembesi	Loose	Ovate	Rose	Neutral	Present
Kozak Gemresi	Loose	Round	Red	Neutral	Present
Abiguş	Loose	Round	Red	Neutral	Present
Kırmızı Şam	Very loose	Round	Red	Little flavour	Present
Mahrabaşı	Loose	Round	Dark red-violet	Neutral	Present
Yuvarlak Razakı	Loose	Round	Green-yellow	Neutral	Present
Siyah Gemre	Loose	Round	Red	Neutral	Present
Pembe Gemre	Loose	Round	Rose	Neutral	Present
Cardinal	Loose	Round	Blue-black	Little aromatic	Present
Beyaz Şam	Loose	Round	Green-yellow	Neutral	Present
Italia	Loose	Round	Red	Little flavour	Present
Ohannes	Loose	Round	Green-yellow	Little flavour	Present
Pek Üzümü	Medium	Obtuse-ovate	Blue-black	Little flavour	Present
Şika	Loose	Ovate	Dark red-violet	Neutral	Present
Müşküle	Loose	Round	Dark red-violet	Neutral	Present
Moiseylative	Medium	Obtuse-ovate	Blue-black	Little flavour	Present
Buca Razakısı	Loose	Long elliptic	Green-yellow	Little flavour	Present
Tarsus Pembesi	Loose	Round	Rose	Neutral	Present
Hafızali	Loose	Obtuse-ovate	Blue-black	Neutral	Absent

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

OIV Cod Number	Tarsus Pembesi*	Buca Razakısı	Moiseylative	Müşküle	Hafızali	Şika	Pek Üzümü
001	Open	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open
003	Very weak	Very weak	Absent	Absent	Very weak	Very weak	Absent
004	Sparse	Very sparse	Sparse	Very sparse	Very sparse	Very sparse	Very sparse
005	None	None	None	None	None	None	None
006	Semi-erect	Semi-erect	Semi-erect	Semi-erect	Semi-erect	Horizontal	Semi-erect
007	Green	G with r.s	G with r.s	G with r.s	Green	Green	G with r.s
008	G with r.s	G with r.s	G with r.s	G with r.s	Green	Green	G with r.s
009	G with r.s	Green	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s
010	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s
011	None	None	None	None	None	None	None
012	None	None	None	None	None	None	None
013	Very sparse	None	None	None	None	None	None
014	None	None	None	None	None	None	None
015	Very weak	Absent	Absent	Very weak	Absent	Very weak	Weak
016	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.
017	Short	Short	Very short	Short	Very short	Short	Very short
051	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.
052	None	None	Very weak	Weak	None	None	None
053	Dense	None	None	None	Very sparse	Very sparse	Very sparse
054	Sparse	None	None	None	None	None	None
055	Sparse	None	None	None	None	None	None
056	None	Very sparse	Very sparse	None	None	Very sparse	None
065	Small	Very small	Very small	Very small	Very small	Very small	Very small
066	Short	Short	Very short	Very short	Short	Short	Short
067	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal
068	Five	Five	Five	Five	Five	Five	Five
069	Medium green	Medium green	Dark green	Pale green	Dark green	Dark green	Dark green
070	Absent	Absent	Very weak	Absent	Absent	Absent	Absent
071	Absent	Absent	Absent	Absent	Absent	Absent	Absent
076	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight
077	Very long	Long	Long	Long	Medium	Very long	Long
078	Long	Long	Long	Long	Long	Long	Medium
079	Wide open	Open	Open	Open	Open	Wide open	Open
080	U shape	V shape	V shape	V shape	U shape	U shape	V shape
081	None	None	None	None	None	None	None
082	Closed	Open	L. s. overlap.	L. s. overlap.	Open	Open	Open
083	V shape	V shape	V shape	U shape	V shape	U shape	V shape
084	None	None	None	None	None	None	None
085	None	None	None	None	None	None	None
086	None	None	Very sparse	None	None	None	Sparse
087	None	Very sparse	None	None	None	None	None
088	Absent	Absent	Absent	Absent	Absent	Absent	Absent
089	Absent	Absent	Absent	Absent	Absent	Absent	Absent
090	None	None	None	None	None	None	None
091	None	None	None	None	None	None	None
092	Very short	Very short	Very short	Very short	Very short	Very short	Very short
093	Shorter	Shorter	Shorter	Longer	Shorter	Shorter	Shorter
151	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite
153	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses

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

OIV Cod Number	Tarsus Pembesi*	Buca Razakısı	Moiseylative	Müşküle	Hafızali	Şika	Pek Üzümü
154		Long	Very long	Long	Medium	Very long	Medium
203		Short	Long	Short	Short	Short	Medium
204		Loose	Medium	Loose	Loose	Loose	Medium
205		Very few	Medium	Few	Very few	Few	Few
206		Very long	Very long	Very long	Very long	Very long	Very long
207		Weak	Medium	Strong	Weak	Weak	Weak
221		Long	Long	Medium	Long	Medium	Medium
222		Not uniform	Not uniform	Not uniform	Not uniform	Uniform	Uniform
223		Long elliptic	Obtuseovate	Round	Obtuseovate	Ovate	Obtuseovate
224		Not circular	Not circular	Circular	Circular	Circular	Circular
225		Green-yellow	Blue-black	Dark red-violet	Blue-black	Dark red-violet	Blue-black
226		Not uniform	Not uniform	Not uniform	Not uniform	Not uniform	Not uniform
230-231		Not coloured	Not coloured	Not coloured	Not coloured	Not coloured	Not coloured
233		Medium	Medium	Medium	Medium	Little	Medium
237		Little flavour	Little flavour	Neutral	Neutral	Neutral	Little flavour
238		Medium	Short	Short	Short	Short	Short
239		Medim	Medim	Easy	Medim	Medim	Medim
241		Present	Present	Present	Absent	Present	Present
301	Late	Late	Late	Medium	Late	Medium	Very early
305	Medium	Medium	Early	Early	Early	Medium	Early
306	Yellow	Yellow	Red-violet	Dark red	Reddish	Reddish	Reddish

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

OIV Cod Number	Beyaz Şam*	Italia	Ohannes	Cardinal	Pembe Gemre*	Siyah Gemre	Yuvarlak Razakı
001	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open
003	Weak	Absent	Very weak	Very weak	Very weak	Absent	Very weak
004	Medium	Dense	Sparse	Very sparse	Medium	Very sparse	Very sparse
005	None	None	None	None	None	None	None
006	Horizontal	Semi-erect	Horizontal	Semi-erect	Semi-erect	Semi-erect	Semi-erect
007	G with r.s	G with r.s	Green	G with r.s	G with r.s	G with r.s	Green
008	G with r.s	Green	G with r.s	G with r.s	G with r.s	G with r.s	Green
009	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	Green
010	G with r.s	Green	G with r.s	G with r.s	G with r.s	G with r.s	Green
011	None	None	None	None	None	None	None
012	None	None	None	None	None	None	None
013	None	None	None	None	None	None	None
014	None	None	None	None	None	None	None
015	Absent	Absent	Weak	Very weak	Absent	Very weak	Absent
016	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.
017	Very short	Very short	Short	Short	Very short	Short	Very short
051	Green with b.s.	Green	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.	Green with b.s.
052	Very weak	None	None	None	None	None	None
053	Very sparse	Medium	Sparse	Sparse	Medium	Very sparse	Çok seyrek
054	None	None	None	None	None	None	None
055	Very sparse	Sparse	None	None	None	None	None
056	Sparse	Sparse	Very sparse	None	Very sparse	None	None
065	Very small	Very small	Very small	Very small	Very small	Very small	Very small
066	Short	Very short	Very short	Short	Short	Short	Short
067	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal
068	Five	Five	Five	Five	Five	Five	Three
069	Medium green	Pale green	Pale green	Dark green	Medium green	Dark green	Medium green
070	Absent	Absent	Absent	Absent	Absent	Absent	Absent
071	Absent	Absent	Absent	Absent	Absent	Absent	Absent
076	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight
077	Long	Short	Long	Medium	Very long	Medium	Long
078	Very long	Short	Long	Long	Very long	Long	Long
079	Open	Wide open	Open	Open	Open	Open	Open
080	V shape	V shape	V shape	U shape	V shape	U shape	U shape
081	None	None	None	None	None	None	None
082	Open	Open	Open	L. s. overlap.	Open	Open	Open
083	U shape	U shape	V shape	U shape	V shape	V shape	U shape
084	None	None	None	None	None	None	None
085	None	Very weak	None	None	None	None	None
086	Very sparse	Very sparse	None	None	Very sparse	Very sparse	Very sparse
087	None	None	None	None	None	None	None
088	Absent	Absent	Absent	Absent	Absent	Absent	Absent
089	Absent	Absent	Absent	Absent	Absent	Absent	Absent
089	Absent	Absent	Absent	Absent	Absent	Absent	Absent
090	None	None	None	None	None	None	None
091	None	None	None	None	None	None	None
092	Very short	Very short	Very short	Very short	Very short	Very short	Very short
093	Shorter	Shorter	Very much shorter	Shorter	Shorter	Shorter	Shorter
151	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite
153	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 3 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses

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

OIV Cod Number	Beyaz Şam*	Italia	Ohannes	Cardinal	Pembe Gemre*	Siyah Gemre	Yuvarlak Razakı
154	Short	Short	Short	Very long	Long	Long	Very long
203		Very short	Short	Short		Short	Short
204		Loose	Loose	Loose		Loose	Loose
205		Very few	Few	Few		Very few	Very few
206		Very long	Very long	Very long		Very long	Very long
207		Strong	Medium	Weak		Weak	Weak
221		Long	Medium	Long		Medium	Medium
222		Uniform	Not uniform	Not uniform		Not uniform	Not uniform
223		Round	Round	Round		Round	Round
224		Not circular	Not circular	Circular		Circular	Circular
225		Red	Green-yellow	Blue-black		Red	Green-yellow
226		Not uniform	Uniform	Uniform		Not uniform	Not uniform
230-231		Not coloured	Slightly coloured	Slightly coloured		Not coloured	Not coloured
233		Medium	Little	Medium		Medium	Little
237		Little flavour	Little flavour	Little aromatic		Neutral	Neutral
238		Short	Short	Short		Short	Short
239		Medim	Medim	Medim		Medim	Difficult
241		Present	Present	Present		Present	Present
301	Medium	Late	Medium	Late	Early	Early	Medium
305	Medium	Medium	Medium	Late	Medium	Early	Medium
306	Yellow	Yellow	Yellow	Yellow	Yellow	Dark red	Red

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

OIV Cod Number	Mahrabaşı*	Kırmızı Şam	Kozak Gemresi	Çeşme Pembesi	Malbee	Grenache	Delbele
001	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open
003	Very weak	Absent	Very weak	Very weak	Very weak	Very weak	Very weak
004	Medium	Sparse	Sparse	Medium	Dense	Dense	Dense
005	None	None	None	None	None	None	None
006	Semi- erect	Semi- erect	Horizontal	Semi- erect	Erect	Erect	Erect
007	Green	G with r.s	Green	G with r.s	G with r.s	G with r.s	Green
008	Green	G with r.s	G with r.s	G with r.s	Red	G with r.s	Green
009	Green	G with r.s	Green	G with r.s	G with r.s	Green	Green
010	Green	Green	G with r.s	Green	G with r.s	Green	Green
011	None	None	None	None	Sparse	Sparse	Sparse
012	None	None	None	None	None	Very sparse	Very sparse
013	None	None	None	None	None	Very sparse	None
014	None	None	None	None	Very sparse	Sparse	Very sparse
015	Very weak	Very weak	Absent	Absent	Weak	Weak	Weak
016	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Sub. or cont.	Dis. cont.	Dis. cont.
017	Very short	Very short	Very short	Short	Very short	Very short	Very short
051	Green with b.s.	Green with b.s.	Green with b.s.	Green	Green with b.s	Green	Yellow
052	None	None	None	Very weak	Weak	None	None
053	Sparse	Very sparse	Very sparse	Dense	Very dense	Dense	Dense
054	None	None	None	None	None	None	None
055	None	None	None	None	None	None	None
056	Sparse	Sparse	None	Sparse	Very sparse	Very sparse	Very sparse
065	Very small	Very small	Very small	Very small	Very small	Small	Very small
066	Short	Short	Short	Short	Very short	Short	Very short
067	Pentagonal	Pentagonal	Wedgeshaped	Pentagonal	Pentagonal	Pentagonal	Pentagonal
068	Five	Five	Five	Three	Five	Five	Five
069	Medium green	Pale green	Medium green	Medium green	Medium green	Dark green	Dark green
070	Absent	Absent	Absent	Absent	Absent	Absent	Absent
071	Very weak	Absent	Absent	Absent	Absent	Absent	Absent
076	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight
077	Medium	Long	Medium	Very long	Medium	Long	Long
078	Short	Long	Short	Long	Medium	Long	Very long
079	Open	Open	Open	Wide open	Open	Open	Open
080	V shape	U shape	V shape	U shape	U shape	V shape	U shape
081	None	None	None	None	None	None	None
082	Open	Open	Closed	L. s. overlap.	Open	Open	Open
083	V shape	V shape	V shape	V shape	U shape	U shape	V shape
084	None	None	None	Sparse	None	Medium	Very sparse
085	None	None	None	None	None	None	None
086	None	None	None	Sparse	Sprase	Medium	None
087	None	None	None	Very sparse	None	None	Sparse
088	Absent	Absent	Absent	Absent	Absent	Present	Absent
089	Absent	Absent	Absent	Absent	Absent	Present	Absent
089	Absent	Absent	Absent	Absent	Absent	Present	Absent
090	None	None	None	None	Very sparse	Sparse	None
091	None	None	None	None	None	None	None
092	Very short	Very short	Very short	Very short	Very short	Very short	Very short
093	Shorter	Shorter	Shorter	Shorter	Shorter	Shorter	Shorter
151	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite

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

OIV Cod Number	Mahrabaşı*	Kırmızı Şam	Kozak Gemresi	Çeşme Pembesi	Malbee	Grenache	Delbele
153	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	Up ot 1 inflorescence	1.1 to 3 inflorescenses	1.1 to 2 inflorescenses
154	Medium	Very long	Long	Medium	Short	Medium	Short
203		Long	Short	Short	Very short	Very short	Very short
204		Very loose	Loose	Loose	Dense	Medium	Medium
205		Few	Few	Few	Very few	Very few	Very few
206		Very long	Very long	Very long	Long	Very long	Very long
207		Medium	Weak	Weak	Weak	Weak	Weak
221		Medium	Short	Long	Short	Short	Short
222		Uniform	Not uniform	Not uniform	Uniform	Uniform	Not uniform
223		Round	Round	Ovate	Round	Round	Obovate
224		Not circular	Circular	Not circular	Circular	Circular	Circular
225		Red	Red	Rose	Blue-black	Blue-black	Blue-black
226		Not uniform	Not uniform	Not uniform	Uniform	Not uniform	Not uniform
230-231		Not coloured	Very slightly coloured	Not coloured	Very slightly coloured	Not coloured	Not coloured
233		Medium	Little	Medium	Medium	Medium	Medium
237		Little flavour	Neutral	Neutral	Neutral	Little flavour	Neutral
238		Short	Short	Short	Very short	Short	Short
239		Medim	Medim	Easy	Medim	Medim	Medim
241		Present	Present	Present	Present	Present	Present
301	Medium	Medium	Early	Medium	Very early	Very early	Medium
305	Early	Medium	Late	Early	Early	Early	Medium
306	Yellow	Yellow	Red-violet	Reddish	Dark red	Dark red	Yellow

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

OIV Cod Number	Alicante Boushet	Merlot	Foça Karası	Petit Syrah	Öküzgözü	Papaz Karası	Cabarnet Sauvignon*
001	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open
003	Weak	Very weak	Very weak	Very weak	Very weak	Very weak	Medium
004	Dense	Dense	Seyrek	Dense	Medium	Dense	Dense
005	None	None	None	None	None	None	None
006	Semi- erect	Erect	Semi- erect	Semi- erect	Horizontal	Semi- erect	Semi- erect
007	G with r.s	G with r.s	Green	G with r.s	G with r.s	G with r.s	G with r.s
008	G with r.s	G with r.s	G with r.s	Green	G with r.s	G with r.s	G with r.s
009	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s	G with r.s
010	G with r.s	G with r.s	Green	G with r.s	G with r.s	Green	Red
011	None	None	None	None	None	Sparse	None
012	Very sparse	None	None	None	None	None	None
013	None	Very sparse	None	None	None	Sparse	Sparse
014	Very sparse	Very sparse	None	None	None	Sparse	Sparse
015	Very weak	Very weak	Absent	Absent	Absent	Absent	Very weak
016	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont	Dis. cont.	Dis. cont.
017	Very short	Short	Very short	Very short	Very short	Very short	Short
051	Green with b.s.	Yellow	Green with b.s.	Green with b.s.	Green with b.s.	Yellow	Green with b.s.
052	None	None	None	None	Weak	None	None
053	Very dense	Very dense	Sparse	Very dense	Very sparse	Very dense	Dense
054	None	None	None	None	None	None	None
055	None	None	None	None	Very sparse	Medium	None
056	Sparse	Sparse	Sparse	Very sparse	None	Very sparse	Very sparse
065	Very small	Very small	Very small	Very small	Very small	Very small	Very small
066	Short	Short	Very short	Very short	Short	Short	Very short
067	Wedgeshaped	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Pentagonal
068	Five	Five	Five	Five	Five	Five	Five
069	Dark green	Dark green	Medium green	Medium green	Medium green	Dark green	Dark green
070	Medium	Absent	Absent	Absent	Very weak	Absent	Absent
071	Weak	Absent	Absent	Absent	Very weak	Absent	Absent
076	B. s. straight	B. s. straight	B. s. straight	B. s. straight	O. s. c, o. s. c.	B. s. straight	B. s. straight
077	Long	Long	Medium	Medium	Short	Long	Long
078	Medium	Long	Long	Medium	Long	Long	Long
079	Open	Open	Open	Open	Open	Open	Open
080	V shape	U shape	V shape	V shape	V shape	V shape	U shape
081	None	None	None	None	None	None	None
082	Open	Open	Open	Open	Open	Open	L. s. overlap.
083	V shape	U shape	V shape	V shape	U shape	U shape	U shape
084	Dense	Sparse	None	Medium	None	Dense	Sparse
085	None	None	None	None	None	None	None
086	Sprase	Very sprase	None	Medium	None	Sparse	None
087	None	None	None	None	None	None	Very sparse
088	Absent	Present	Absent	Absent	Absent	Present	Absent
089	Absent	Absent	Absent	Absent	Absent	Absent	Absent
089	Absent	Absent	Absent	Absent	Absent	Absent	Absent
090	None	None	None	None	None	None	None
091	Very sparse	None	None	None	None	None	None
092	Very short	Very short	Very short	Very short	Very short	Very short	Very short
093	Shorter	Shorter	Shorter	Shorter	Shorter	Shorter	Shorter
151	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite
153	1.1 to 2 inflorescenses	Up to 1 inflorescence	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	Up to 1 inflorescence

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

OIV Cod Number	Alicante Boushet	Merlot	Foça Karası	Petit Syrah	Öküzgözü	Papaz Karası	Cabarnet Sauvignon*
153	1.1 to 2 inflorescenses	Up to 1 inflorescence	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	Up to 1 inflorescence
154	Long	Medium	Medium	Medium	Medium	Medium	Medium
203	Very short	Very short	Very short		Short	Medium	
204	Very dense	Very dense	Very dense		Loose	Very dense	
205	Very few	Medium	Medium		Very few	Medium	
206	Very long	Short		Short	Very short	Very long	
207	Weak	Weak	Weak	Medium	Medium	Weak	
221	Short	Short		Short	Medium	Short	
222	Not uniform	Uniform		Uniform	Not uniform	Not uniform	
223	Slightly flat	Round		Round	Slightly flat	Round	
224	Not circular	Circular		Circular	Circular	Circular	
225	Blue-black	Blue-black		Blue-black	Rose	Red	
226	Not uniform	Uniform		Not uniform	Uniform	Uniform	
230-231	Very strong coloured	Very slightly		Not coloured	Very slightly	Not coloured	
233	Medium	Medium		Medium	Medium	Medium	
237	Little flavour	Little aromatic		Neutral	Little flavour	Little flavour	
238	Short	Very short		Short	Short	Short	
239	Medium	Medium		Medium	Medium	Easy	
241	Present	Present		Present	Present	Absent	
301	Medium	Çok erken	Medium	Very early	Medium	Medium	Early
305	Early	Early	Medium	Very early	Medium	Medium	Early
306	Red-violet	Red	Yellow	Red-violet	Yellow	Red	Red-violet

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

OIV Cod Number	Cabarnet Franc*	Cınsaut	Grenache Noir*	Colombard	Harsleleh	Semillion	Abiguş*
001	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open	Half-open
003	Medium	Weak	Very weak	Absent	Very weak	Weak	Absent
004	Medium	Dense	Sparse	Dense	Dense	Medium	Very sparse
005	None	None	None	None	None	None	None
006	Erect	Semi- erect	Erect	Semi- erect	Semi- erect	Semi- erect	
007	G with r.s	Green	Green	G with r.s	G with r.s	Green	
008	Red	Green	Green	G with r.s	G with r.s	G with r.s	
009	Red	G with r.s	Green	G with r.s	G with r.s	Green	
010	Red	G with r.s	Green	G with r.s	G with r.s	G with r.s	
011	None	None	None	None	None	None	
012	Very sparse	None	None	None	None	None	
013	None	None	None	None	None	None	
014	Very sparse	None	None	Sparse	Very sparse	None	
015	Very weak	Absent	Absent	Medium	Absent	Very weak	
016	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	Dis. cont.	
017	Very short	Very short	Very short	Very short	Very short	Very short	
051	Reddish	Reddish	Green	Green	Yellow	Green with b.s.	Green
052	Weak	None	None	None	None	Very weak	
053	Very dense	Dense	Very sparse	Very dense	Very dense	Dense	Very sparse
054	None	None	None	None	None	None	
055	None	Very sparse	None	Sparse	Medium	Sparse	
056	Very sparse	Sparse	Sparse	None	Sparse	Very sparse	None
065	Very small	Very small	Very small	Very small	Very small	Very small	
066	Very short	Very short	Very short	Short	Short	Very short	
067	Pentagonal	Pentagonal	Pentagonal	Pentagonal	Cordate	Pentagonal	
068	Five	Five	Five	Five	Five	Five	
069	Dark green	Medium green	Pale green	Dark green	Medium green	Açık yeşil	
070	Very weak	Absent	Absent	Absent	Absent	Absent	
071	Very weak	Absent	Absent	Absent	Absent	Absent	
076	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	B. s. straight	
077	Medium	Long	Medium	Medium	Medium	Long	
078	Long	Short	Short	Short	Short	Medium	
079	Open	Open	Open	Open	Open	Wide open	
080	U shape	V shape	V shape	V shape	U shape	U shape	
081	None	None	None	None	None	None	
082	Open	Open	L. s. overlap.	Open	Open	L. s. overlap.	
083	U shape	V shape	V shape	U shape	V shape	U shape	
084	Sprase	Very sprase	None	Medium	Medium	Very sprase	
085	None	Very weak	None	Weak	None	None	
086	None	None	Very sparse	None	Sprase	Very sprase	
087	None	Very sparse	None	Sparse	None	None	
088	Present	Absent	Absent	Absent	Absent	Absent	
089	Absent	Absent	Absent	Absent	Absent	Absent	
090	None	Very sparse	None	None	None	None	
091	Very sparse	None	None	None	Sparse	Very dense	
092	Very short	Very short	Very short	Very short	Very short	Very short	
093	Shorter	Shorter	Shorter	Shorter	Shorter	Shorter	
151	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	Hermaphrodite	
153	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	1.1 to 2 inflorescenses	

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

OIV Cod Number	Cabarnet Franc*	Cınsaut	Grenache Noir*	Colombard	Harsleleh	Semillion	Abiguş*
154	Short	Medium	Medium	Short	Medium	Medium	
203		Very short		Very short	Very short	Very short	
204		Dense		Medium	Loose	Dense	
205		Very few		Few	Medium	Few	
206		Long		Long	Long	Long	
207		Medium		Weak	Weak	Weak	
221		Short		Short	Short	Short	
222		Uniform		Not uniform	Not uniform	Uniform	
223		Long elliptic		Obtuseovate	Round	Slightly flat	
224		Circular		Not circular	Circular	Not circular	
225		Blue-black		Green-yellow	Rose	Rose	
226		Not uniform		Not uniform	Not uniform	Not uniform	
230-231		Not coloured		Not coloured	Not coloured	Not coloured	
233		Medium		Medium	Medium	Medium	
237		Neutral		Neutral	Little aromatic	Neutral	
238		Short		Short	Short	Short	
239		Difficult		Easy	Easy	Medium	
241		Present		Present	Present	Absent	
301	Early	Very early	Late	Very early	Medium	Early	
305	Early	Very early	Medium	Early	Medium	Medium	
306	Dark red	Red-violet	Yellow	Yellow	Yellow	Yellow	

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*; Mahrabaşı*; Granache Noir*: Grape varieties that could not be observed in their maturity due to lack of sufficient number of clusters that could be analyzed.

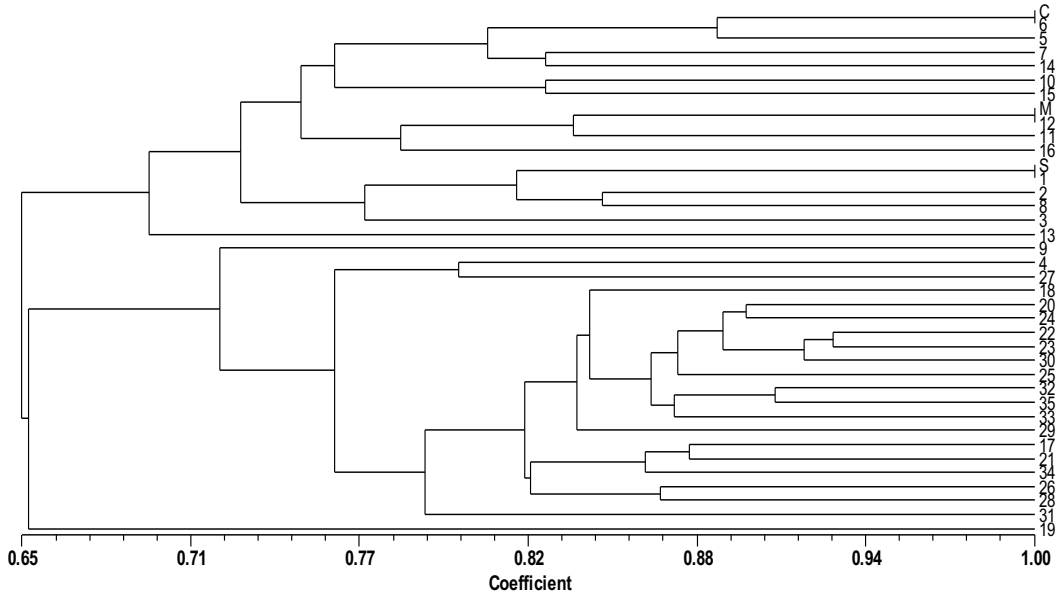

Figure 1. Dendrogram showing the relationships of 38 grapevine cultivars used in this study based on UPGMA cluster analysis of 73 features in "Descriptors for Grape"

C: Cabernet Sauvignon, M: Merlot, S: Sémillon, 1: Sémillon, 2: Marsleleh, 3: Conlonbart, 4: Grenache Noir, 5: Cinsaut, 6: Cabernet Franc, 7: Cabernet Sauvignon, 8: Papazkarası, 9: Öküzgözü, 10: Petit Syrah, 11: Foça Karası, 12: Merlot, 13: Alicante Boushet, 14: Delbele, 15: Grenache, 16: Malbee, 17: Çeşme Pembesi, 18: Kozak Gemresi 19: Abiguş, 20: Kırmızı Şam, 21: Mahrabaşı, 22: Yuvarlak Razakı, 23: Siyah Gemre, 24: Pembe Gemre, 25: Cardinal, 26: Beyaz Şam,27: Italia, 28: Ohannes, 29: Pek Üzümü, 30: Şika, 31: Müşküle, 32: Moiseylative, 33: Buca Razakısı, 34: Tarsus Pembesi, 35: Hafızali

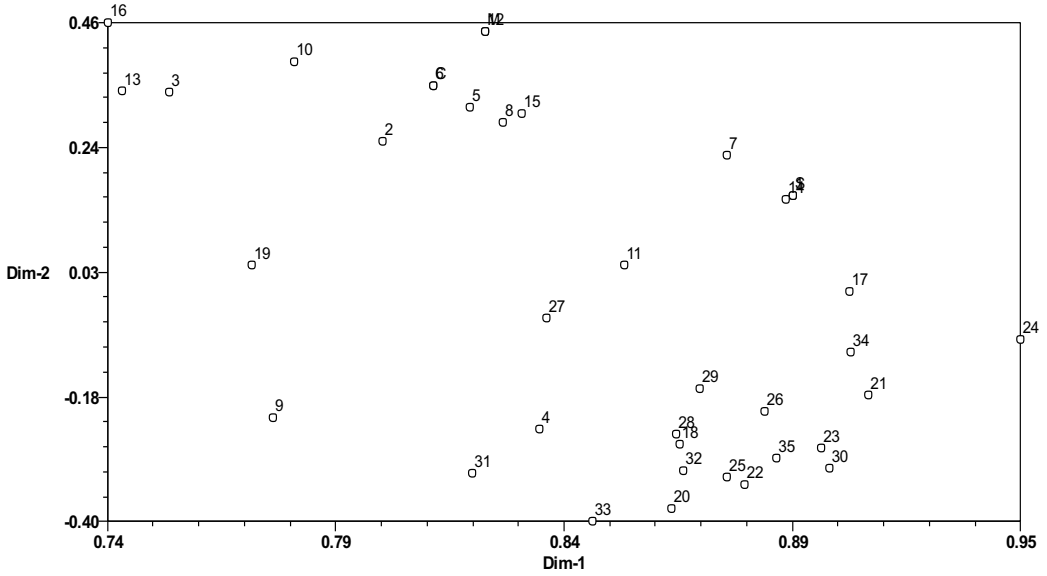

Figure 2. Principal component analyses of 38 grapevine cultivars used in this study based on 73 ampelographic characteristics

C: Cabernet Sauvignon, M: Merlot, S: Sémillon, 1: Sémillon, 2: Marsleleh, 3: Conlonbart, 4: Grenache Noir, 5: Cinsaut, 6: Cabernet Franc, 7: Cabernet Sauvignon, 8: Papazkarası, 9: Öküzgözü, 10: Petit Syrah, 11: Foça Karası, 12: Merlot, 13: Alicante Boushet, 14: Delbele, 15: Grenache, 16: Malbee, 17: Çeşme Pembesi, 18: Kozak Gemresi 19: Abiguş, 20: Kırmızı Şam, 21: Mahrabaşı, 22: Yuvarlak Razakı, 23: Siyah Gemre, 24: Pembe Gemre, 25: Cardinal, 26: Beyaz Şam,27: Italia, 28: Ohannes, 29: Pek Üzümü, 30: Şika, 31: Müşküle, 32: Moiseylative, 33: Buca Razakısı, 34: Tarsus Pembesi, 35: Hafızali