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Morphological Characterization of Endangered Wild Grapevine *Vitis vinifera* ssp. *silvestris* in Eastern Turkey

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Abstract

Vitis vinifera L. ssp. *silvestris* (Gmelin) Hegi selections from three regions in Eastern Anatolia (Turkey) were morphologically characterized in this study. The wild populations were typically located in hilly areas and on the sides of valleys. Samples from six populations including 26 individual, distinctive *Vitis vinifera* ssp. *silvestris* vines were observed in 2010 by ampelographic evaluation using 35 OIV descriptors (OIV, 1983), modified by Project GENRES 081 (2001). These descriptors from the OIV list include young shoot, shoot, mature leaf, woody shoot, flower sexual organ and berry descriptors. Three hermaphroditic individuals were found, highlighting the differences between the wild and cultivated grapevine. The plants were grouped into four groups, using a cluster dendrogram, that generally matched the original location of each of the individual vines. Morphological characterization of wild grapevine *Vitis vinifera* ssp. *silvestris* in eastern Turkey is the first step in preserving this valuable genetic resource.

Grapevine (*Vitis vinifera* L.) is an important species worldwide with a long history of cultivation. However, initiatives to further improve the species through breeding and selection are likely to be more successful if the range of types that are available within wild populations are more completely defined and identified. *Vitis vinifera* ssp. *silvestris* is known as the ancestor of cultivated grapevines and hence is an important representative within this genus (Zohary, 1995).

The earliest evidence of grape cultivation dates back to the fourth millenium in the Middle East (Zohary and Hopf, 2000). McGovern (2003) suggests that humans developed interest in wild grapes during the Paleolithic period in the upland regions of eastern Turkey, northern Syria, or/and in north-western Iran. Archeological and historical evidence suggest that very early domestication occured in the Near East. Seeds of domesticated grapes dated from ~ 8000 BP have also been found in Georgia and in Turkey (This et al., 2006). McGovern (2003) and Olmo (1976) suggested that there is a monocentric origin of viticulture where domestication started from a restricted pool of wild plants.

The Upper Tigris Valley, in the Anatolian part of the Fertile Crescent, has indisputable significance during the early Neolithic period in terms of the opportunities provided for the permanent settlement of human communities (Hauptmann, 2002; Aurenche, 2007; Özkaya and Çoşkun, 2009). The initial stages of human settlement that occurred in Near East were initiated in the south-east of Anatolia (Özkaya and Çoşkun, 2009). This region has wild grapevine populations and a rich diversity of local genotypes (Karataş et al., 2007).

Two of the eight plant genetic centres (Near East and Mediterranean) intersect within Turkey, as determined by Vavilov (1951) in his work on distribution of plant genetic

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centres. Anatolia has long been linked with the origin of viticulture and wine making, especially in its eastern and southeastern regions, which earlier authors commonly ascribe as being the origin of these practices (Ağaoğlu and Çelik, 1985).

In studies aimed at determining the distribution of wild grapevine populations, it has been shown that wild grapevines were present in France (This et al., 2001; Lacombe et al., 2003), Italy (Anzani et al., 1990; Failla et al., 1992; Grassi et al., 2003; Zecca et al., 2009), Spain (Ocete et al., 2002; de Andres et al., 2012), Germany, Switzerland (Perret, 1997), Portugal (Cunha et al., 2007; Cunha et al., 2009), Bulgaria (Dzhambazova et al., 2009), Tunisia (Snoussi et al., 2004), Georgia (Ekhvaia and Akhalkatsi, 2010), Iran (McGovern, 2004), Hungary (Bodor et al., 2010), and Turkey (Schumann, 1972; Söylemezoğlu et al., 2001; McGovern, 2003; Uzun and Bayir, 2010; Ergül et al., 2011).

Recent studies have reported that wild grapevine populations are progressively decreasing in Europe (Arnold et al., 2005; Grassi et al., 2006; This et al., 2006; Di Vecchi-Staraz et al., 2009; Zecca et al., 2009). This extinction of wild grapevines in their natural habitat represents an irreversible loss in grapevine biodiversity. In the 1980s the wild grapevine was added to the IUCN (International Union for Conservation) list of endangered European species (Ocete et al., 2008).

The ancestral species, *Vitis vinifera* L. ssp. s*ilvestris,* occurs naturally in Eastern Turkey. Although wild grapevine populations exist in wide areas across Turkey, information regarding biological, cultural and ampelographic properties is very limited (İnceoğlu et al., 2000; Söylemezoğlu et al., 2001; Çelik et al., 2005; Uzun and Bayir, 2010; Ergül et al., 2011). However, some studies that aimed to preserve wild grapevine populations in different parts of Turkey, have been conducted over recent years (Uzun et al., 1996; Çelik et al., 2005).

This et al. (2006) indicated that analysis of wild grapes from eastern countries, such as Turkey, Iran and Georgia, the presumed centre of primo-domestication, is fundamental to the understanding of the role of *Vitis vinifera* ssp. s*ilvestris* in the domestication process. Thus, in the present study, an ampelographic description of wild populations was carried out as an intial stage in the protection of wild grapevine germplasm sited in the eastern region of Turkey.

Materials and Methods

Plant material and habitat description

The six studied populations were located in three provinces sited in the eastern region of Turkey (Diyarbakır, Elazığ and Siirt provinces). These populations were the source of 26 individual vines (Fig. 1 and Table 1).

In this study, the wild populations were usually located in both hilly areas and on the sides of valleys. Distribution of wild grapevine populations in these areas is usually remote from agricultural and residential areas. They are natural lands which have not been degenerated or markedly altered over long

Table 1. Town, province, coordinates and altitude of origin of the 26 selected wild grapevines (*Vitis vinifera* spp *silvestris*) included in this study.

Town	Province	Coordinates	Altitude (m)	Number of selected individuals
Çüngüş	Diyarbakır	37° 55.2' N 40°13.8'E	1150	4
Lice	Diyarbakır	38° 27′ N 40°39′E	1125	7
Kulp	Diyarbakır	38° 30.06' N 41°0.42' E	850	1
Ergani	Diyarbakır	38° 16.09' N 39°45.42' E	955	2
Maden	Elazığ	38° 40.8'N 39°13.8'E	1300	9
Pervari	Siirt	37° 55.8'N 41°57.0'E	1380	3

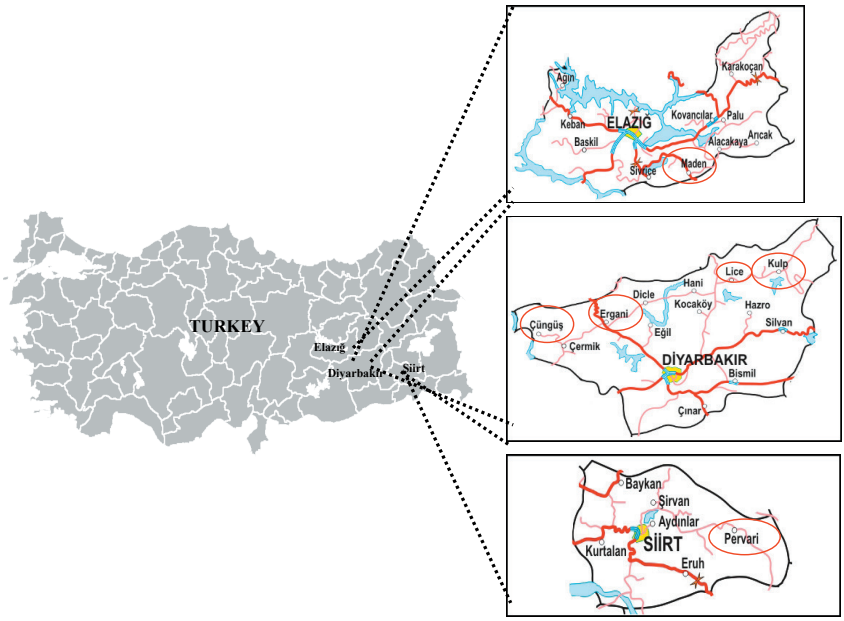

Fig. 1. Collection sites of *Vitis vinifera* spp *silvestris* from Eastern Turkey, located in Elazı, Diyarbakır and Siirt provinces.

periods of time. Çüngüş and Lice, both within the Diyarbakır province, are characteristic mountainous regions, while Kulp is located in the foothills of a volcanic mountainous region. Kulp has characteristic red-colored "terra rosa" soils. Ergani is characterized by high mountains that surround the valley and it has been shown that it is one of the very early places of human settlement. Wild vine types were found along river edges in this region. Maden (Elazığ province) is located in high mountains and the samples were collected from around the Maden River. Pervari, in the province of Siirt, is also mountainous.

The climatic conditions amongst the sites from which the samples were collected, are characterised, in general, as having a large temperature difference between night and day, hot and dry summers, and cold winters - a harsh terrestrial climate is dominant.

Amphelographic description

The 26 samples of *Vitis vinifera* ssp. *silvestris* vines were described in 2010 using ampelographic characteristization based on OIV descriptors (OIV, 1983), modified by Project GENRES 081 (2001; www.genres.de/vitis/vitis.htm). A total of 35 descriptors from the OIV list were used, including the features for describing young shoots (four descriptors), woody shoots (four descriptors), mature leaves (19 descriptors), woody shoots (three descriptors), flower sexual organs (one descriptor), and berries (four descriptors; for more details see Tables 2 and 3).

Data analysis

Multivariate methods were used to observe similarities between the 26 individuals based on ampelographic data. Firstly, the ampelographic dataset was reduced by removing all common characters. Hierarchical clustering was carried out using correlation coefficients and an "Unweighted Pair Group Method Analysis" (UPGMA) (Garcia-Muñoz et al., 2011). For this analysis, 24 characters were selected (see Tables 2 and 3). Correspondence analysis (CA) was carried out to iden-

Table 2. Characteristics of young shoot, shoot, mature leaf and the inflorescence (OIV, 1983, modified by Project GENRES 081, 2001) of wild plants collected from 13 populations from two provinces in eastern Turkey.

OIV descriptor	Coded selections													Observed values
	M1	M2	M3	M4	M5	M6	M7	M8	M9	Ç1	Ç2	Ç3	Ç4	
OIV-001	3	3	5	5	5	5	5	5	5	5	5	5	5	3,5
OIV-003	1	1	3	3	1	1	3	3	1	1	1	3	1	1,3
OIV-004	1	1	3	3	3	3	1	1	3	1	1	3	1	1, 3
OIV-005	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-015-1	4	4	4	4	2	3	4	4	1	4	4	2	1	1, 2, 3, 4
OIV-015-2	7	7	5	5	1	5	9	9	1	9	9	1	1	1, 5,7, 9
OIV-017	1	1	1	3	1	3	3	1	3	1	3	1	1	1,3
OIV-065	1	1	1	1	1	1	1	1	1	1	1	1	3	1,3
OIV-067	2	2	4	2	4	4	3	3	4	3	3	3	3	2,3,4
OIV-068	2	2	1	2	2	1	3	2	2	2	3	3	3	1,2,3
OIV-069	5	3	7	7	5	3	7	5	7	7	7	3	7	3,5,7
OIV-070	3	2	4	4	2	2	3	3	2	3	3	3	2	2,3,4
OIV-071	3	2	4	4	2	2	3	3	2	3	3	3	2	2,3,4
OIV-072	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-073	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-076	3	3	3	3	3	3	2	3	3	3	3	3	3	2,3
OIV-079	3	3	3	3	3	3	3	3	3	5	3	3	5	3,5
OIV-080	1	3	1	3	3	3	1	1	3	3	1	1	3	1,3
OIV-081-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-081-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-082	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-084	5	3	3	3	3	1	1	1	3	3	3	3	1	1,3,5
OIV-085	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-086	7	3	5	5	5	3	3	3	3	3	3	3	3	3,5,7
OIV-087	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-093	3	3	3	5	3	3	3	5	5	1	3	3	3	1,3,5
OIV-101	1	1	1	2	1	1	1	1	1	1	1	3	1	1,2,3
OIV-102	2	2	1	1	2	1	2	1	1	1	2	2	1	1,2
OIV-103	2	4	2	2	4	4	3	3	4	4	2	4	4	2,3,4
OIV-353	3	3	3	3	1	3	3	5	3	3	3	3	3	1,3,5
OIV-151	2	2	3	1	1	1	2	1	1	2	2	2	2	1,2,3
OIV-220	-	-	1	-	-	-	-	-	-	-	-	-	-	1
OIV-221	-	-	1	-	-	-	-	-	-	-	-	-	-	1
OIV-223	-	-	2	-	-	-	-	-	-	-	-	-	-	2
OIV-225	-	-	6	-	-	-	-	-	-	-	-	-	-	6

M: Maden-Elazığ province, Ç: Çüngüs-Diyarbakır province

tify the most influential descriptors and their relationships with the wild grapevine individuals that were described (Garcia-Muñoz et al., 2011).

Results and Discussion

Morphological characterization of wild grapevines

The 26 individuals of *Vitis vinifera* ssp *silvestris* were found in well preserved natural habitats, especially in mountainous areas and alongside rivers, as observed by other authors (Muñoz-Organero et al., 2008; Ocete et al., 2008; Uzun and Bayir, 2010; de Andres et al., 2012).

In general, the individuals that were studied showed small mature leaf blades (OIV-065), anthocyanin coloration of main veins on the upper side of mature leaf blades (OIV-070), an open petiole sinus on mature leaf blades (OIV-079), a low density of prostrate hairs between the main veins on the lower side of mature leaf blades (OIV-084) and the plants were dioecious (OIV-151). These results match with the ampelographic characterization made in a number of other

Table 3. Characteristics of young shoot, shoot, mature leaf and the inflorescence (OIV, 1983, modified by Project GENRES 081, 2001) of wild plants collected from 13 populations from two provinces in eastern Turkey.

OIV descriptor	Coded selections													Observed values
	L1	L2	L3	L4	L5	L6	L7	K1	E1	E2	S1	S2	S3	
OIV-001	3	3	3	5	5	5	5	5	5	3	5	5	5	3,5
OIV-003	3	1	3	1	1	1	1	1	1	1	1	1	1	1,3
OIV-004	3	3	1	3	1	1	1	3	3	1	3	1	1	1,3
OIV-005	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-015-1	1	1	2	2	2	2	2	1	2	4	2	2	2	1,2
OIV-015-2	1	1	3	3	3	3	3	1	3	7	3	3	3	1,3,7
OIV-017	1	1	3	1	1	1	3	1	1	3	3	1	1	1,3
OIV-065	3	3	3	3	5	5	3	3	5	3	3	3	3	3,5
OIV-067	3	3	4	3	3	2	3	3	3	3	2	3	2	2,3,4
OIV-068	2	2	1	3	3	1	3	3	3	3	2	2	2	1,2,3
OIV-069	3	5	3	5	5	5	5	5	3	5	5	5	5	3,5
OIV-070	3	3	3	4	3	2	2	3	2	3	3	3	3	2,3,4
OIV-071	2	2	3	4	3	2	2	3	2	3	3	3	3	2,3
OIV-072	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-073	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-076	3	3	3	3	3	2	2	3	3	2	2	2	2	2,3
OIV-079	3	3	3	3	5	3	5	5	5	3	3	3	3	3,5
OIV-080	1	1	3	1	1	3	1	1	3	1	1	1	3	1,3
OIV-081-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-081-2	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-082	1	1	1	1	1	1	1	1	1	1	5	1	5	1,5
OIV-084	1	1	3	3	5	5	3	3	1	1	3	3	3	1,3,5
OIV-085	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-086	1	1	3	1	3	3	1	3	1	1	3	3	3	1,3
OIV-087	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV-093	3	3	1	5	3	3	3	3	3	3	3	5	3	1,3,5
OIV-101	2	3	1	1	1	1	1	1	1	1	1	1	3	1,2,3
OIV-102	2	2	2	2	2	2	2	1	1	1	2	1	2	1,2
OIV-103	2	2	4	4	3	4	3	4	3	3	4	4	4	2,3,4
OIV-353	7	9	7	7	7	7	9	5	3	1	3	7	3	1,3,5,7,9
OIV-151	1	3	2	1	1	2	1	3	1	1	1	2	1	1,2,3
OIV-220	-	1	-	-	-	-	-	1	-	-	-	-	-	1
OIV-221	-	1	-	-	-	-	-	1	-	-	-	-	-	1
OIV-223	-	2	-	-	-	-	-	2	-	-	-	-	-	2
OIV-225	-	6	-	-	-	-	-	6	-	-	-	-	-	6

L: Lice-Diyarbakır province, K: Kulp-Diyarbakır province, E: Ergani-Diyarbakır province, S: Pervari-Siirt province

wild grapevines studies (Cunha et al., 2007; Franco Mora et al., 2008; Muñoz-Organero et al., 2008). Differentiation between *Vitis vinifera* ssp *silvestris* and *Vitis vinifera* ssp *sativa* is not easy to establish because of the similarity between wild and domesticated plants (This et al., 2006; de Andres et al., 2012). However, the type of flower (OIV-151; dioecious for wild plants), and the opening of the shoot tip (OIV-001; open for wild plants) are two descriptors that seem to be appropriate for establishing such differences (This et al., 2006; Cunha et al., 2007).

In this study, three hermaphrodite plants were found in the natural sites of collection. However these plants showed berry characters typical of wild grapevines including a very short berry length (OIV 220), very narrow berry width (OIV 221), globose berry shape (OIV 223), and blue-black berry color (OIV 225), as described in other wild vines (This et al., 2006; Muñoz-Organero et al., 2008; de Andres et al., 2012). Cunha et al. (2007) indicate that hermaphrodite plants do occur

in wild populations but at rates not exceeding 5%. Nonetheless, a higher proportion of hermaphrodite plants was found in this study.

It should be noted that, aside from the hermaphrodites, only male individuals were found in the studied populations. However, wild populations with only male or female individuals have previously been described (Muñoz-Organero et al., 2008) with the proportions of female and male plants being highly variable in wild populations (Söylemezoglu et al., 2001; Cunha et al., 2007; de Andres et al., 2012). A greater number of sampled individual vines may have identified a higher frequency of female vines. However, the presence of this unusual rate between male and female plants could be due to (1) a process of adaptation over years to the local environmental conditions (Negi and Olmo, 1971), (2) the coexistence in the natural habitat of wild grapevines with naturalized grapevine cultivars (de Andres et al., 2012), and (3) extensive vegetative cloning (Rottenberg, 1998). Although male individuals have previously been associated with rootstocks (Pospisilovâ et al., 2010; de Andres et al., 2012), this possibility seems invalid in our study as the populations were found far away from both human settlements and agricultural areas (around 5-10 km). Further, American rootstocks are not used in these areas, which follow traditional viticulture practices, as phylloxera is not present and it is possible to identify vines of around 100 years old. Furthermore, symptoms of phylloxera have not been found in the studied populations as has been pointed out in other wild populations (Ocete et al., 2008). The possibility of hybridization between these wild plants and American rootstocks is, therefore, very remote.

With regard to the degree of opening of the young shoot, six plants in this study had a half open shoot tip. This character has not been previously described for wild plants, but it has been pointed out that wild vine phenotypes could be related to cultivated grapevine phenotypes (Cunha et al., 2009) or be adapted to a particular location (Cunha et al., 2007). Regardless, this common characteristic within these populations could be due to the long viticulture history of this area. It is believed that Turkey is one of the domestication centers of grapevines (Ağaoğlu and Çelik, 1985; Uzun and Bayir, 2010) and this region is very rich in local grape varieties (about 200 are known). Therefore these plants with a half open shoot tip could represent very old genotypes.

Genetic characterization of this material should be performed to verify their identity more precisely.

Grouping of wild grapevines

The six populations of wild grapevines that were studied showed morphological differences among the individuals within each population confirming the findings of previous studies (Grassi et al., 2006; Cunha et al., 2007; Ocete et al., 2008; Cunha et al., 2009). The development of these distinct morphologic characteristics within wild individuals could be due to adaptation to local environmental conditions (Cunha et al., 2009).

When considering the morphological characterization of these wild grapevines, at a similarity level >0.44, four groups could be distinguished where the individual's origin was a key factor in the classification (Fig. 2). All the individuals observed in Lice (Diyarbakir province) were in the first group which was formed by nine individuals that had a very small mature leaf blade (OIV-065) and short internodes (OIV-353; Fig. 2 and 3).

The second group included five individuals. Two of them were from Maden (Elazığ province; M5, M9), two from Çüngüş (Diyarbakır province; Ç3, Ç4) and the remaining one was from Kulp (Diyarbakır province; K1). All individuals of this group had no or very weak intensity of anthocyanin coloration on the bud (OIV-015-2) with the main color of the woody shoot being grey (OIV-103; Fig. 2 and 3).

The third group included only two out of

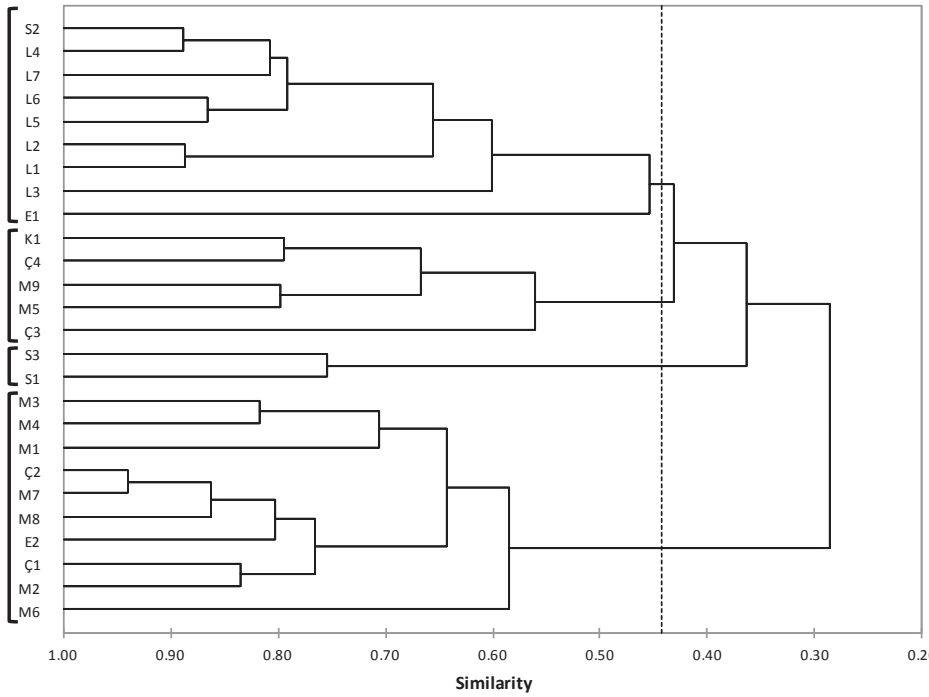

Fig. 2. Similarity among the 26 studied individuals based on the ampelographic descriptions and revealed by cluster dendrogram, using an UPGMA method and correlation coefficients. (Codes shown in Tables 2 and 3).

the three individuals from Pervari (Siirt province). These two individuals were characterized by the absence of a sinus on the mature leaf (OIV-082; Fig. 2 and 3) and they showed three lobes in the mature leaves as has been previously described in other studies (Campostrini et al., 1993; Cunha et al., 2007; Failla et al., 1992).

The last group (the largest one) included ten individuals, most of them (seven) were from Maden (Elazığ province). This group was characterized by having a distribution of anthocyanin coloration in more than three-quarters of the bud (OIV-015-1) and by the strong or very strong intensity of anthocyanin coloration on the bud (OIV-015-2; Fig. 2 and 3).

Conclusions

Six natural populations of *Vitis vinifera* L. ssp. *silvestris* were studied from three provinces of eastern Turkey, being the first time that these wild grapevines had been thoroughly characterized in this region. Ampelographic characterization proved to be a good method for describing the plant material collected in this study. The 26 vines were grouped into four groups that closely, but not entirely followed the site of origin of each individual.

The ampelographic characterization of these plants represents the first step in the preservation of this wild grapevine resource in Turkey. The individuals identified in this study could represent very old varieties and be a valuable source of biodiversity. The preservation of such specimens is essential for both avoiding the extinction of these unique grapevines and for maintaining genetic variability. Equally, these wild specimens are a source of traits that may potentially be useful in breeding programs.

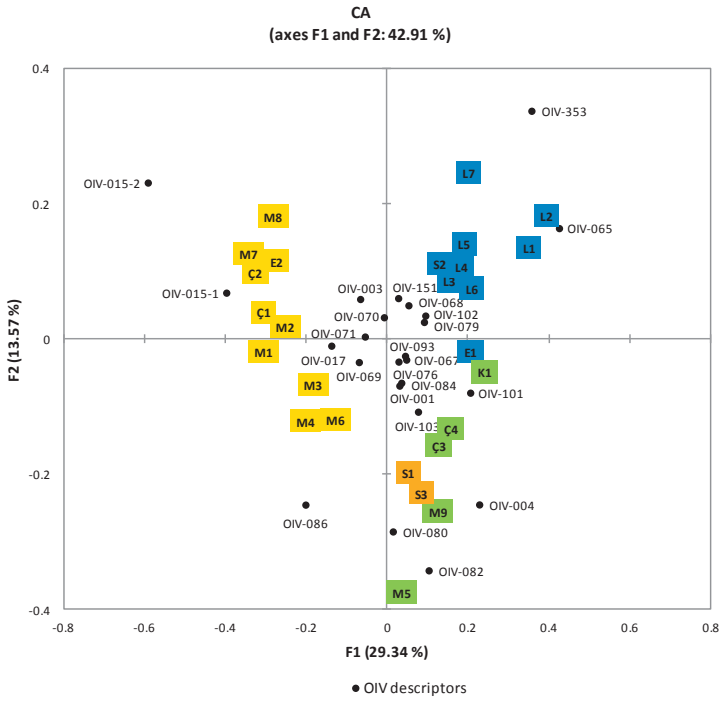

Fig. 3. Source of variation for the OIV descriptors as projected by correspondence analysis (CA). The shading of each individual matches with the group revealed using the cluster dendrogram (see Fig. 2).

Genetic analysis of these plants is required to verify their identity.

Literature Cited

Ağaoğlu, Y.S. and H. Çelik. 1985. Conservation of germplasm of *Vitis vinifera* L. in Turkey. 4th International Symposium on Grapevine Breeding, Communications 40-42:13-18. April 1985, Verona (Italy).

Anzani, R., O. Failla, A. Scienza, and E. Campostrini. 1990. Wild grapevine (*Vitis vinifera* ssp. *silvestris*) in Italy: Distribution characteristics and germplasm preservation. Proc. 5th Int. Symp. Grape Breeding, 12-16 Sept. 1989, St. Martin/Pfalz, FRG. Vitis, Special Issue, 97-113.

Arnold, C., A. Schnitzler, A. Dourad, R. Peter, and F. Oıs Gillet. 2005. Is there a future for wild grapevine *(Vitis vinifera* ssp. s*ilvestris*) in the Rhine Valley? Biodivers. Conserv. 14:1507-1523.

Aurenche, O. 2007. Das ‚Goldene Dreieck' un die Anfaenge des Neolithikums im Vorderen Orient. Vor 12.000 Jahren in Anatolien, Die Aeltesten Monumente der Menschheit:50-65.

Campostrini, F., R. Anzani, O. Failla, F. Iacono, A. Scienza, and L. De Micheli. 1993. Application de l'analyse phyllomètrique à la classification géographique de la population italienne de la vigne savage (*Vitis vinifera* L. ssp. *silvestris*). J. Int. Sci. Vigne Vin. 27:255-262.

Cunha, J., M. Baleiras Couto, J.P. Cunha, J. Banza, A. Soveral, L.C. Carneiro, and J.E. Eiras-Dias. 2007. Characterization of Portuguese populations of *Vitis vinifera* L. ssp. *sylvestris* (Gmelin) Hegi. Genet. Resour. Crop. Evol. 54:981-988.

Cunha, J., T. Santos, C. Carneiro, P. Fevereiro, and J.E. Eiras-Dias. 2009. Portuguese traditional grapevine cultivars and wild vines (*Vitis vinifera* L.) share morphological and genetic traits. Genet. Resour. Crop Evol. 56(7):975-989.

Çelik, S., E. Bahar, I. Korkutal, and K. Demir. 2005. Türkiye'de Doğal Olarak Yetişen Yabani Asmanın (*V. vinifera ssp. silvestris*) Tanımlanması ve Üretimde Kullanılabilme Olanakları Üzerine Araştırma. Türkiye 6. Bağcılık Sempozyum, Bildiriler, Cilt:1:22-31. 19-23 Eylül 2005, Tekirdağ.

de Andres, M.T., A. Benito, G. Perez-Rivera, R. Ocete, M.A. Lopez, L. Gaforio, G. Muñoz, F. Cabello, J.M. Martinez-Zapater, and R. Arroyo-Garcia. 2012.

Genetic diversity of wild grapevine populations in Spain and their genetic relationships with cultivated grapevines. Mol. Eco. 21(4):800-816.

Di Vecchi-Staraz, M., V. Laucou, G. Bruno, T. Lacombe, S. Gerber, T. Vourse, M. Boselli, and P. This. 2009. Low level of pollen-mediated gene flow from cultivated to wild grapevine: consequences for the evolution of the endangered subspecies *Vitis vinifera* L. subsp. *silvestris*. J. Hered. 100:66-75.

Dzhambazova, T., I. Tsvetkov, I. Atanassov, K. Rusanov, J.M. Martinez-Zapater, A. Atanassov, and T. Hvarleva. 2009. Genetic diversity in native Bulgarian grapevine germplasm (*Vitis vinifera* L.) based on nuclear and chloroplast microsatellite polymorphisms. Vitis 48(3):115-121.

Ekhvaia, J. and M. Akhalkatsi. 2010. Morphological variation and relationships of Georgian populations of *Vitis vinifera* L. subsp. *sylvestris* (C.C. Gmel.) Hegi. Flora 205(9):608-617.

Ergül, A., G. Perez-Rivera, G. Söylemezoğlu, K. Kazan, and R. Arroyo-Garcia. 2011. Genetic diversity in Anatolian wild grapes (*Vitis vinifera* subsp. *sylvestris*) estimated by SSR markers. Plant Genetic Resources 9(3):375-383.

European Union Project GENRES 081 (2001). Primary and secondary descriptor list for grapevine cultivars and species (*Vitis* L.). Institut für Rebenzüchtung Geilweilerhof. Siebeldingen, Germany.

Failla, O., R. Anzani, and A. Scienza. 1992. La vite selvatica in Italia: diffusione, caratteristiche e conservazione del germoplasma. Vignevini 19(1/2):37-46.

Franco Mora, O., E.J. Morales Rosales, and A. Gonzalez-Huerta. 2008. Vegetative characterization of wild grapevines (*Vitis* ssp.) native to Puebla, Mexico. HortScience 43(7):1991-1995.

Garcia-Muñoz, S., G. Muñoz-Organero, M.T. de Andres, and F. Cabello. 2011. Ampelography an old technique with future uses: the case of minor varieties of *Vitis vinifera* L. from the Balearic Islands. J. Int. Sci. Vigne Vin. 45(3):125-137.

Grassi, F., M. Labra, S. Imazıo, A. Spada, S. Sgorbati, A. Scienza, and F. Sala. 2003. Evidence of secondary grapevine domestication centre detected by SSR analysis. Theor. Appl. Genet. 107:1315-1320.

Grassi, F., M. Labra, S. Imazıo, R. Ocete Rubio, O. Failla, A. Scienza, and F. Sala. 2006. Phylogeographical structure and conservation genetics of wild grapevine. Conserv. Gen. 7:837-845.

Hauptmann, H. 2002. Upper Mesopotamia in its regional context during the early Neolithic. Pp. 263-275. In: F. Gerard and I. Thissen (eds.). The Neolithic of Central Anatolia: internal developments and external relations during the 9th-6th millenia BC. Istanbul, Turkey.

İnceoğlu, O., M. Pinar, and E. Donmez Oybak. 2000. Pollen morphology of wild *V. slyvestris* Gmelin (Vitaceae). Turkish J. Bot. 24:147-150.

Karataş, H., D. Değirmenci, R. Velasco, S. Vezzulli, Ç. Bodur, and Y.S. Ağaoğlu. 2007. Microsatellite fingerprinting of homonymous grapevine (*Vitis vinifera* L.) varieties in neighboring regions of South-East Turkey. Scientia Hort. 114(3):164-169.

Lacombe, T., V. Laucou, M. Di Vecchi, L. Bordenave, T. Bourse, R. Siret, J. David, J.M. Boursiquot, A. Bronner, D. Merdinoglu, and P. This. 2003. Inventory and characterızatıon of *Vitis vinifera* ssp. s*ilvestris* in France. Acta Hort. 603:553-557.

McGovern, P.E. 2003. Ancient wine: the search of the origin of the viniculture. Princeton University Press, New Jersey.

Muñoz-Organero, G., F. Cabello, A. Benito, S. Garcia-Muñoz, L. Gaforio, C. Rubio, M.A. Lopez, and R. Ocete. 2008. Characterization of wild grapevines (*Vitis vinifera* subsp. *sylvestris*) in Spain. 31st OIV World Congress of Vine and Wine. 6th General Assembly of the OIV, 15-20 June 2008, Verona, Italy.

Negi, S.S. and H.P. Olmo. 1971. Conversion and determination of sex in *Vitis vinifera* L. (*sylvestris*). Vitis 9:265-279.

Ocete R., M. Cantos, M.A. Lopez, I. Gomez, and A. Troncoso. 2002. Wild grapevine populations in the Ossa-Morena mountain range (Portugal - Spain): location, characterization and sanitary state. Vitis 41:55-56.

Ocete, R., M.A. López, A. Gallardo, and C. Arnold. 2008. Comparative analysis of wild and cultivated grapevine (*Vitis vinifera*) in the Basque Region of Spain and France. Agr. Ecosyst. Environ. 123(1-3):95-98.

Olmo, H.P. 1976. Evolution of crop plants (ed. N.W. Simmonds), pp. 294–298. Longman, London.

OIV. 1983. Descriptor list for grape vine varieties and *Vitis species*. Ed OIV, Paris.

Özkaya, V. and A. Coşkun. 2009. "Körtik Tepe, a new pre-pottery neolithic site in south-eastern Anatolia", Antiquity, Project Gallery 83:320. http://antiquity.ac.uk/projgall/ozkaya/

Perret, M. 1997. Polymorphisme des génotypes sauvages et cultivés de *Vitis vinifera* L. détécté à l'aide de marqueurs RAPD. Bulletin de la Société Neuchateloise des Sciences Naturelles 120:45-54.

Pospisilovâ, D., R. Simüra, and D. Sekera. 2010. Research work on *Vitis vinifera* ssp. *sylvestris* in Slovakia. Czech J. Genet. Plant Breed. 46:47-49.

Schumann, F. 1972. Notes on the occurence of wild grapes in Turkey. Notizen zum Vorkommen von

Wildreben in der Tuerkei. Wein-Wiss. 32:169-173.
Snoussi, H., M.H.B. Slimane, L. Ruiz-Garcia, J.M. Martinez-Zapater, and R. Arroyo-Garcia. 2004. Genetic relationship among cultivated and wild grapevine accessions from Tunisia. Genome 47:1211-1219.
Söylemezoğlu, G., Y.S. Ağaoğlu, and H.I. Uzun. 2001. Ampelographic characteristics and isozymic analysis of *Vitis vinifera* ssp. *silvestris* Gmel. in southwestern Turkey. J. Biotechnol. 2:106-113.
This, P. 2001. Caracterisation de la diveriste d'une population de vignes sauvages du Pic Saint-Loup (Herault) et relations avec le compartiment cultive. Genetic. Selec. Evol. 33:289-304.
This, P., T. Lacombe, and M.R. Thomas. 2006. Historical origins and genetic diversity of wine grapes. Trend Genet. 22(9):511-519.
Uzun, I.H. and A. Bayir, 2010. Distribution of wild and cultivated grapes in Turkey. Notulae Scientia Biologicae 2(4):83-87.
Uzun, İ., Y.S. Ağaoğlu, and G. Söylemezoğlu. 1996. Distribution and isozymic analysis of wild grapevines (*Vitis vinifera* ssp. *silvestris* Gmel.) in Turkey. Int. symposium on *in-situ* conservation of plant genetic resources. Central Res. Ins. for Field Crops. Ankara.
Uzun, I.H. and A. Bayir. 2010. Distribution of wild and cultivated grapes in Turkey. Notulae Scientia Biologicae 2(4):83-87.
Vavilov, N.I. 1951. The origin, variation, immunity and breeding of cultivated plants. The Chronica Botanica, Cambridge, UK, pp. 293-350.
Zecca, G., F. de Mattia, G. Lovicu, M. Labra, F. Sala, and F. Grassi. 2009. Wild grapevine: silvestris, hybrids or cultivars that escaped from vineyards? Molecular evidence in Sardinia. Plant Biology ISSN 1435-8603:1-6.
Zohary, D. 1995. Domestication of the grapevine *Vitis vinifera* L. in the Near East. Pp. 23-30. In: P.E. McGovern, S. Fleming, and S.M. Katz (eds.). The origins and ancient history of wine. Gordon and Breach.
Zohary, D. and M. Hopf. 2000. Domestication of plants in the world: the origin and spread of cultivated plants in west Asia, Europe and Nile Valley. Oxford University Press, England.

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Modelling of weather parameters to predict russet on 'Golden Delicious' apple.

Abstract:
Russet on 'Golden Delicious' apple (*Malus* x *domestica* Borkh.) fruit is a physiological disorder that causes major economic losses to growers. Large variations occur in the severity of russet from one year to another. In Girona (Spain), good correlations were found between the annual severity of russet at harvest and several weather parameters measured shortly after full bloom. A specific statistical methodology for the analysis of compositional data (CoDa) was used to establish these correlations. The most important factor was the percentage of time at relative humidity values > 55% from 30 – 34 d after full bloom (DAFB), which yielded a high correlation (R = 0.80). The percentage of rainy days from 0 – 34 DAFB was also positively correlated with the severity of russet (R = 0.80). Ordinal logit regression models that included these two climatic variables strongly predicted a low, moderate, or high annual severity of russet. Understanding the effects of weather on russet, and developing predictive models may help to manage the marketing of this apple variety which is prone to russet in some areas of cultivation.

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