Grapevine throughout the History of Anatolia

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Abstract: Anatolian peninsula has been the cradle of not only the ancient civilizations but also many agriculturally important crops. It has long been linked with the origins of viticulture and wine-making. Shrines, seeds, wine cups and reliefs have been discovered in different regions of the country. One of its accepted origins, Anatolia has not only the cultivated grapevine (Vitis vinifera L.) which has presented itself with numerous cultivars and types but also the wild grapevine (Vitis sylvestris). This paper is on the history of grapevine starting from prehistoric times to the current with classical and later on molecular studies, based on DNA such as RAPD, AFLP and SSR, on cultivar identification and potential in Anatolia.

Key words: Anatolia, Turkey, ancient grape, ampelography, cultivar, wild grape

INTRODUCTION

Geographically, Turkey forms a natural bridge between the old world continents of Asia, Africa and Europe. The Anatolian peninsula is the westernmost point of Asia, divided from Europe by the Bosphorus and Dardanelles straits. It covers an area of 81,457 square kilometers or 314,510 square miles.

Turkey is under the influence of three different climates, namely, Mediterranean, continental and oceanic. Most of Turkey is under the Mediterranean influence. The Central Anatolian Plateau and the more eastern mountainous parts enjoy continental climate. Oceanic climate occurs only in an enclave in the northeastern part around the Rize province (Akman and Ketenoglu, 1986; Baser, 2002). Turkey is situated at the junction of three important phytogeographic regions, namely Mediterranean, Irano-Turanian and Euro-Siberian. The Black Sea’s coastal areas are in the Euro-Siberian region. Areas surrounding the Mediterranean, Aegean and Marmara Seas enjoy the characteristics of the Mediterranean regions and finally, the large part of Turkey stretching from the Central Anatolian Plateau to the borders with Iran and Iraq to the east and southeast lies in the Irano-Turanian region. Endemic species are largely found in the Mediterranean and Irano-Turanian regions. The Anatolian flora, especially in the more arid areas, is said to be in an active state of diversification (Davis, 1971).

Near-East, one of the origin centers of plant, contains parts of Iran, Iraq, Turkey, Syria, Jordan, Lebanon and Israel where the early development of food production took place (Miller, 2006). Plant cultivation in the Near-East started about 10,000 Before Present (BP). Two thousand years later, by 7,000 BC, most of the crop plants that the Near-East has contributed to food production had been brought into cultivation. At about 7000 BC village farming had become firmly established and agriculture had spread beyond its Near Eastern nuclear area (Van Zeist, 1992).

Anatolia has long been linked with the origins of viticulture and wine-making, especially in its eastern region to which the ancient authors commonly ascribe its origins (Gorny, 1996).

Earliest traces of viticulture have been recovered in the settlements dated back to Early Bronze Age, east of the Mediterranean basin, among which Troy and Kınaktepe (Çanakkale) (Rhiel, 1999), Yenibademli Höyük (Göççeada) and Gre Virike and Kurban Höyük (Samlıurfa) (Miller, 1986). Archaeological and historical evidence suggest that primo-domestication of grapevine occurred in the near-East (This et al., 2006). Refai (2002) reported that grapes, together with olive and fig, were more commonly used throughout the Bronze Age in the Mediterranean. Lloyd and Mellaart (1958) discovered grape pips in a shrine in western Turkey dating from the Early Bronze Age. A wine shop with storage jars and drinking cups from the Late Bronze age were also found (Macqueen, 1986). Seeds of domesticated grapes were also found in Turkey and Georgia dated from approximately 8000 years ago (Marinval, 1997). Dönnmez (2005) found very small quantities of grape seeds in Göççeada, Çanakkale.

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The cultivation of vines for the making of wine originated some time before 4000 BC and possibly as early as 6000 BC in the mountainous region between the Black Sea and the Caspian Sea, bordering Turkey, Syria, Iraq, Iran and Georgia (Billiard, 1913; Lutz, 1922; Levadoux, 1956; Negru, 1960; Younger, 1966; Ramishvili, 1983; Hyams, 1987; Johnson, 1989). This probable hearth of viticulture laid to the north of great plains of the Tigris and Euphrates, which formed the core of the Sumerian, Akkadian, Assyrian and Babylonian empires and also to the east of the heartland of the Hittite empire in what is now Turkey (Unwin, 1996). Viticulture was apparently quite well established in Anatolia by 1000 BC, supported by a relief at Ivriz, near Tarsus, showing a god adorned with a vine (Billiard, 1913) and by a pillar from Kalamammaras that illustrates a god holding a bunch of grapes in one hand (Barnett, 1980). Schlee (1995) reported that chemical analysis of remnants in a cuvette found in Titris Höyük (Sanliurfa) revealed tartaric acid, indicating the possibility of using the cuvette for crushing grapes. Urartians (600–99 BC) who mainly situated around Van region mentioned in their written texts the viticulture and the wine making (Belli, 2006). Few grape seeds were excavated in Van, a sign of Urartian plant cultivation of grapevine (Donmez and Belli, 2007).

Wild grapevine (Vitis vinifera ssp. sylvestris Gmelin) has found itself a place from Portugal to Turkmenistan and from Rhine riversides to northern forests of Tunisia (Levadoux, 1956; Arnold et al., 1998; McGovern, 2004). Schumann (1977) and Agaoğlu and Çelik (1987) reported the existence of wild grapevine in many places of Anatolia. The oldest wild grape (Vitis sylvestris Gmelin) seeds were excavated in Turkey at Nevalı Çorî, near Urfa on the slope of Euphrates side valley 8400 years ago (Hauptmann, 1997; Pasternak, 1998). Analyses of chlorotype diversity in sylvestris populations showed central Mediterranean and eastern populations had higher diversity values than western populations (Arroyo-Garcia et al., 2006), in agreement with Negru in 1938, suggesting that the Anatolian peninsula and Transcaucasian regions are the ‘diversity center’ of Vitis vinifera, based on phenotypic variation.

Cultivated grapevines are thought to have been domesticated from wild populations of Vitis vinifera ssp. sylvestris (Levadoux, 1956). Vitis vinifera L. is the only species of the genus Vitis indigenous to Eurasia and is suggested to have first appeared 65 million years ago (de Saporta, 1879). Zohary and Hopf (2000) stated that the domestication process involved the selection of hermaphrodite genotypes that produced larger and sweeter fruits of attractive colors and the development of techniques for their vegetative propagation. Analysis of variation in seed morphology aimed by Terral et al. (2010) to provide criteria for the discrimination between wild grapes and modern cultivars and to understand changes in functional traits in relation to the domestication process. The position of ‘Henab’ (Turkey) and ‘Muscat d a Petit Grains’ (Greece) group within a cluster consisting of the ‘Cabernet franc’, ‘Merlot’ and ‘Pinot’ groups could suggest relationship between European and Eastern varieties. Authors speculated that this might reflect the scale of trade, which spread grapevine by vegetative propagation through the Mediterranean basin.

AMPELOGRAPHIC STUDIES

Earlier works on investigation of grapevine germplasm diversity in Anatolia have involved ampelographic studies mostly done by the researchers at the universities. First scientific ampelographic study was performed on grape cultivars grown in Ankara by Orman (1957). Orman and Aksoy (1945), Fidan et al. (1972), Marasali (1986) and Demir (1987) were the other scientists who investigated ampelographic features of grapes in the same area. Anameric (1964) and Odabas (1984) profiled grape cultivars grown in Çanakkale and Iğdır, respectively. Çelik (1989) and Çelik (1990) investigated ampelographic characteristics of some grape cultivars grown in Amasya and Kastamonu, respectively. Other studies were as follows; in Tokat ( Kara, 1990), Gevas, Van (Kelen and Tekintas, 1991), Southeastern Anatolia, mainly Urfa (Gursoz, 1993), Delice, Kirikkale (Dursun, 1994), Beypazari-Güdül, Ankara (Gemalmaz, 1994), Kaleik, Ankara (Aktepe, 1994), Diyarbakir and Mardin (Kaplan, 1993), Baysel, Konya (Kara and Beyoglu, 1995), Gaziantep, Sanlıurfa, Adıyaman and Kalamammaras (Adlı and Arpaci, 1995), Incesu, Kayseri (Türkkan and Ağaoglu, 1999), Safranbolu, Karabük (Kucukkalkanci, 1996), Sungurlu, Corum (Diri, 1996), Meram, Konya (Akkt, 1998), Hırran plain, Urfa (Dili, 1997), Isparta (Ecem and Kelen, 1999), Ordu (Cangi, 1999), Malatya (Ünal, 2000), Silifke, Mersin (Sanlıurfa, 2000), Merzifon, Amasya (Kose et al., 2004), Diyarbakır and Mardin (Kaplan and Fidan, 2005), Pervari, Siirt (Güler, 2007), Aegean region (Kader and Dilli, 2009) and Afyon (Akdeniz and Altindisli, 2009). There were also some studies on the genetic diversity of Isabella grape cultivar (Vitis labrusca L.). Melek and Çelik (2005) collected 26 accessions of Isabella cultivar from Sinop and surrounding towns and profiled their ampelographic characteristics and found that at least 11 accessions were different from each other. Çelik et al. (2009) determined 13 Isabella genotypes collected from central Samsun city and Çarsamba. Fox grapes (Vitis labrusca L.) grown in Artvin and Rize provinces were ampelographically profiled by Çelik et al. (2008).
Isoenzyme studies were also used to distinguish grapevine cultivars grown in Turkey (Agaoglu et al., 1995, 1998, 1999; Soylemenezoglu et al., 1998, 2001; Türkben et al., 2002) with differing results in terms of the enzyme systems that help distinguishing grape cultivars.

After the development of Polymerase Chain Reaction (PCR) by Kary B. Mullis in 1983, molecular markers have helped in distinguishing grape cultivars and accessions on DNA level. Studies involving DNA markers, such as RAPD, AFLP and microsatellites have been frequently used for genetic identification of grape cultivars indigenous to Anatolia.

Seventeen grape cultivars (Amasya, Bessni, Bogazkere, Bozcada Çavuşu, Emir, Hafifizali, Hasanede, Hınıs, Kadın pınarmığı, Kozak beyazi, Kozak siyahı, Muskiče, Narince, Öküçözü, Papaz kurası, Razaki, Tahanbebi) grown in different parts of Turkey were identified with RAPD markers (Ergul et al., 2002). The cultivars were separated into 4 groups on the basis of genetic variability and regional diversity.

There are several varietal groups of grapevine, such as Misket, Dimrit, Genmre, Parmak, Büzgüli and Amasya, widely cultivated all over Turkey. Ergul et al. (2004) studied five genotypes of ‘Amasya’ gathered from Çankakale, Sakarya, Denizli, Tokat and Kocaeli for genetic identification using AFLP technique. According to the results, all ‘Amasya’ genotypes were different from each other. Aras et al. (2005) used 14 accessions of ‘Büzgüli’ varietal group from Antalya, Kütahya, Konya, Denizli, Eskisehir, Mugla and Ankara to determine genetic similarity with RAPD and they found that the genotypes had high level of genetic similarities. Soylemenezoglu et al. (2005) genetically identified 13 ‘İskelebey Misketi’ accessions collected from Edirne, Tekirdag, Denizli, Manisa, Mugla and Çanakkale using AFLP markers. Six genotypes were found closely related to ‘Muscat of Alexandria’, implying that these genotypes might have played some role in the development of this cultivar. Selli et al. (2007) analyzed genetic diversity within ‘Dimrit’ and ‘Genmre’ cultivar groups at eight microsatellite loci. ‘Genmre’ accessions (9) were collected from the regions of central Anatolia, Aegean and Thrace, while ‘Dimrit’ group (22) were from Mediterranean, central Anatolia and Aegean regions. The groups made two distinct groups with homonymous and synonymous cases within each group. Microsatellites were used to identify 22 accessions of grapevine cultivar ‘Dimrit’, collected from Mersin, Konya, Denizli, Mugla, Burdur, Isparta and Kirşehir (Boz et al., 2009). They found one synonymy and four homonymies. Geographical distribution and genetic relationship did not show any significant correlation, an indication of high genetic diversity in this varietal group.

Ergul et al. (2006) studied the AFLP-based genetic relations of the grapevine accession of two important Anatolian varietal groups, ‘Misket’ and ‘Parmak’. ‘Misket’ accessions (10) were collected from Thrace and Aegean regions, while ‘Parmak’ accessions (15) were gathered from the regions of Mediterranean, Thrace, central Anatolia, southeastern Anatolia and western Black Sea. Results showed that both groups contained a number of homonymy and synonymy. Six of the Anatolian ‘Misket’ genotypes were very similar to ‘Muscat of Alexandria’.

Karagöz (2006) genetically characterized a total of 48 grape cultivars (Vitis vinifera L.) consisting of 35 local grape cultivars from Gaziantep and 11 cultivars from Tekirdag Viticulture Research Institute in National Germplasm Repository Vineyard with 2 reference cultivars were genetically characterized using 17 SSR markers. Two cases of synonymy were revealed for the genotypes (Dusuzu and Dimiski, Runmi from Gaziantep and Runmi from Tekirdag) and 5 cases of homonymy were observed. Kisütümü and Sergi kurası, Sari Kabaroğlu and Serpenekirin from Gaziantep showed close genetic relationship. Therefore, the researcher reported that they may be regarded as the same cultivar.

Boz et al. (2007) used microsatellites to genotype 113 grape accessions gathered from the Marmara Region and 65 from SE Anatolia. No synonymy cases were detected in the regions. However, 14 and 5 cases of homonymy were observed from Marmara and SE Anatolia regions, respectively. No synonymy showed that these regions have very rich diverse genetic background.

Karakas et al. (2007) fingerprinted using SSR 16 grapevine cultivars that had the same name in Urfa and Gaziantep (Çilores, Çilorut, Hınıs, Dimiski, Kabaroğlu, Külahi, Hatunpınarmığı, Sergi kurası, Kızılahtası, Azezi, Yediveren, Serpenekirin, Kazılabanlı, Gölgülü, Hoşorozkurasi and Muhammediye). The results showed a large degree of genetic variability among most of the homonymous cultivars.

Korkmaz (2007) compared five grape accessions collected from Urfa, Izmir to 93 grapevine accessions which included 13 European accessions with SSR and AFLP markers. She found that two of the Urfa accessions were completely different from the other accessions.

Thirty-five autochthonous grapevine cultivars growing in Çoruh Valley in NE Anatolia were investigated for their genetic relation using RAPD. (Ercişi et al., 2008). Cluster analysis showed that genotypes present in the valley are very distinguishable.

Dilli (2008) studied on a total of 31 grape cultivars (Vitis vinifera L.) consisting of 5 types Sultani Çekerdeksiz, 9 clones of Pembe Genmre, Osmanca and Ipek cultivars selected by Manisa Viticulture Research
Institute and 15 local grape varieties plus 2 reference cultivars of economic importance in the Aegean Region to genetically characterize and establish genetic relationship using SSR. One case of homonymy was revealed for the genotypes of Foça Karase collected from Aydın, Çağalakale, İzmir (Mordogan) and Dumanlı Genme variety.

Hizarcı (2010) carried out a molecular identification with SSR study on 25 grapevine cultivars grown at Yüssufeli district of Artvin province. The cultivars Razaki and Kirmizi Istanbul were found to be the closest with 92% similarity ratio. The lowest similarity ratio was observed between Kütük-Yağ, Kokulu-Yağ Kibris-Cabernet Sauvignon and Kiskinbur-Cabernet Sauvignon with 17% similarity ratio.

Some of the 21 local genotypes collected from central, Ercis and Gevas towns of Van province, six standard cultivars and 3 American grape rootstocks were investigated molecularly by RAPD method and similarity and relations among them were determined (Sensoy, 2008). Standard cultivars, Ercis and Gevas genotypes were generally discriminated in different groups. Moreover, based on the genetic variation among the genotypes, the variation in Gevas and Ercis genotypes were higher than that of standard cultivars.

Karatas and Agaoğlu (2008) estimated genetic relationships among 46 grape cultivars of Gaziantep province using RAPD. There found to be high genetic variation among the cultivars in the region. In general no relationship was encountered between the genetic similarity and previous amelagographic analyses in the cultivars.

Genetic relationships between grape accessions grown in İskilip, Çorum were investigated with RAPD (Agaoglu et al., 2009). The names of the accessions were Sapiuzun, İskilip Karasi, Misket, Sungurlu beyazi, İskilip misketi, Oltuklu üzüm, Süber üzümü, Mahallikara, Beyaziziz, Okçu, Sapli üzüm, Kokulu, Erkenesıube and Tilkikuyuıru. Results indicated that similarity index between İskilip and Çorum local grape cultivars was high. Although genetic similarity index of cultivars was close to each other, some similar named cultivars showing similar morphological characteristics were grouped separately on the dendogram constructed using similarity values.

Genetic analyses of 59 grape cultivars of eastern Mediterranean region were performed using SSR (Tangolar et al., 2009). Homonymy (8 cases) and synonymy (5 cases) were determined. The control cultivars ‘Merlot’ and ‘Cabernet Sauvignon’ were distantly related.

Sabir et al. (2009) studied amelagographic and molecular (ISSR) characterization of 29 indigenous grape cultivars grown at the Research and Implementation area of Çukurova University, Adana.

VARIETY GERPLASM COLLECTIONS

Vitis International Variety Catalogue, developed by Julius Kühn-Institut-Federale Research Centre for Cultivated Plants, stationed in Geilweilerhof, Germany, contains 19,539 registered cultivars from all around the world (http://www.vivc.de). Turkey has contributed to this catalogue with 808 cultivars, which comprises of 4.14% of the total cultivars. Turkey is preceded with France, Italy, United States of America and Germany in terms of the number of cultivars contributed to the catalogue.

Efforts to establish a cultivar germplasm collection in Turkey started in 1965 at the Viticulture Research Institute in Tekirdağ with approximately 1200 cultivars collected from all regions of Turkey. Over time, there have been some genotypes added or, regrettably, lost to the collection. In 2006, one comprehensive research project has been launched with the financial support of TUBITAK by the Biotechnology Institute of Ankara University in cooperation with the Ministry of Agriculture and Rural Affairs to genetically identify all grapevine accessions in the National Grapevine Germplasm Collection at the Viticulture Research Institute, Tekirdağ, Turkey. The project is completed, in which a total of 1150 cultivars were screened with 21 microsatellites and it was found that 850 cultivars were identified as unique genotypes.

One other germplasm collection was started at the grounds of Viticultural Research Institute of Manisa in 2004 and has now around 174 local grape cultivars grown mainly in Aegean region of Turkey (Saglam et al., 2009).

CONCLUSION

Anatolia has a long history in cultivation of many agriculturally important crops. Grape, especially wine, has played an especially significant role throughout its history. Studies presented here in this paper are only representative of a great genetic potential where maybe most of the country is still uninvestigated. Amelagographic studies, mostly involving molecular markers, have been underway on either big or small scale throughout the country by the universities or state agricultural offices which would almost certainly increase the number of the grapevine cultivars and types grown.

REFERENCES


Akdeniz, B.D. and A. Altundisli, 2009. Amelography of some native grape varieties (Vitis vinifera L.) which tend to disappear in Ayonkarashar region. Proceedings of the 7th National Vitic. and Technology Symposium, Oct. 5-9, Manisa, Turkey.


Kaplan, N. and Y. Fidan, 2005. Investigations on the flower and fruit traits of the grape cultivars grown in Diyarbakır and Mardin provinces of Turkey. II. Cultivars for fresh consumption/drying and frying. Proceedings of the 6th Turkey Viticulture Symposium, Sept. 19-23, Tekirdag, Turkey, pp. 525-531.


