

# Determination of Fox grape genotypes (*Vitis labrusca* L.) grown in Northeastern Anatolia

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**ABSTRACT:** Northeastern part of Anatolia is a gene center of grapevine and a wide diversity of Fox grapes grow here. Viticulture and some grapevines in the Black Sea Region (in the north of Turkey) are on the verge of extinction; several types and varieties grown in this region have never been described and did not survive till present. For the past 10 years vineyards and grapevines in the Black Sea Region have been studied. In the present study, eighteen grapevines of foxy taste grown in the Artvin and Rize provinces were described. An ampelographic description of young shoot, mature shoot, young leaf, mature leaf, berry, bunch and seed were carried out using the OIV (Office International de la Vigne et du Vin) list for grapevine cultivars and *Vitis* species. However, several other parameters of the cultivars were measured for evaluation.

**Keywords:** Fox grape (*Vitis labrusca* L.); description; OIV; UPOV; Turkey

Grapevines are native to Asia Minor; Turkey is one of the most important gene pools of grapevines in the world with about 1,500 cultivars that were naturally selected over the centuries. It is believed that cultivation of grapes in this region began 5,000 years ago (ORAMAN 1972). Many researchers reported that in Turkey wild grapes can be found in the forests and banks of rivers up to the altitude of 1,600 m above sea level (AĞAOĞLU, ÇELİK 1987). Nearly all Turkish regions have favorable ecological conditions for viticulture (ÇELİK et al. 1998). Only at higher altitudes of Eastern Anatolia and Black Sea Coastal Region (Northern Anatolia) where the rainfall is over 2,000 mm, viticulture has certain limitations. However, Southeastern Anatolia has a wide range of Fox grape (American grapes) populations (ORAMAN 1972; ÇELİK et al. 1998; ÇELİK 2004). Wild grapevines are also found in a very large area from Europe to Turkmenistan in Eurasia (ORAMAN 1972). European grape (*Vitis vinifera* L.) cultivars do not ripen well in the Black Sea region (Northern part of Turkey) because of heavy rainfall in spring and autumn and insufficient sunshine during vegetation period. The *Vinifera* cultivars in this area are rather

restricted due to climatic conditions resulting in widespread fungal disease, low fertility and poor quality or late ripening (ÇELİK et al. 1998; ÇELİK 2004). Rize and Artvin provinces (region along the Northern part of Anatolia) lie on the 41<sup>st</sup> latitude at the Black Sea Coast Belt in the Northeastern Turkey; tea used to be grown here as monoculture. In this region, a large diversity of Fox grape (*Vitis labrusca*) genotypes (native or open-pollinated types) grow with pergola system in the backyards or on redwood trees in the forests. Among others, the most frequent types are Isabella, black grape, black fox grape, aromatic grape and strawberry grape.

These grapes have foxy flavor, thick and slip skin, special aromatic characteristics, and are consumed as table grapes, used in marmalade and pickle or berry juice for local requirements (CANGI 1999; ÇELİK 2004). According to some previous researches, Fox grapes grown in this region are also resistant to fungal diseases (ÇELİK 2004); however, their detailed ampelographic characteristics were not determined in the past. Characterizing the diversity of local Fox grape populations may allow a more useful application of these materials in breeding programs.

American or French-American hybrids of Fox grapes like Beta, Cynthiana, Mars, Venus, Concord, Delaware, Catawba and Niagara are grown on limited acreages in North America; they were derived from North America native *Vitis labrusca* and an unknown *Vinifera*, and were probably created by random pollination as a result of the 18<sup>th</sup> century attempts to establish European vines in the U.S. *Labrusca* grapes are also found in colder regions of Eastern Europe. These species have relatively low sugar, low acid, low pH, soft pulp with thick skin, and few moderate-size berries per bunch; they suit best for fresh use and for jam, juice, wine, pekmez and jelly production. Fruit flavors are described as foxy or like passion fruit. Fox grapes (*Vitis labrusca* L.) are generally more resistant to fungal diseases than *Vinifera* species. They can be used as a rootstock in the areas where phylloxera disease is prevalent and can also be used in breeding programs with *Vitis vinifera* in order to impart its resistance (WINKLER et al. 1974; WEAVER 1976; ANTCLIFF 1997; ÇELİK 2004). Furthermore, HARDIE and CİRAMI (1997) reported that *Labrusca* grapes seem to tolerate acidic soil conditions such as those in Northeastern Turkey.

Ampelography is a scientific branch focused on differentiation and identification of grapevine varieties and hybrids. As varietal confusions continuously occur, the importance of developing an identification procedure increases (MORTON 1979; FIDAN 1985). Ampelographic studies have been made since the 17<sup>th</sup> century; the characteristics of many grapes were determined by different researchers in various countries (KARA 1990; SCHNEIDER, MANINI 1994; MARTINEZ, PEREZ 1999; BRAYKOV et al. 2002; ZAHEDI et al. 2002; RUSSO et al. 2004). Determination of grape characters used to be based on "Descriptor for Grapevine (*Vitis* spp.)" prepared by the International Board of Plant Genetic Resources (IBPGR) in 1983; however, the latest list was developed in cooperation with Office International de la Vigne et du Vin (OIV) and the International Union for the Pro-

tection of New Varieties of Plants (UPOV) in 1997 (ANONYMOUS 1997). The ampelographic studies in Turkey were first made by ORAMAN (1972); since then, these studies have been carried out by different researchers for about thirty years (ODABAS 1984; MARASALI 1986; AĞAOĞLU et al. 1989; KARA 1990; KELEN, TEKINTAS 1991; GURSOZ 1993; ECEVIT et al. 1997; ECEVIT, KELEN 1999; MELEK, ÇELİK 2005; ŞANLI, ODABAS 2005).

The objective of this study was to determine the ampelographic characters of Fox grape (*Vitis labrusca* L.) genotypes grown in Rize and Artvin provinces in the Northeastern part of Turkey in compliance with the OIV and IBPGR descriptors.

## MATERIALS AND METHODS

The plant material studied was collected from Artvin (Arhavi and Hopa districts) and Rize (Ardeşen, Pazar, Fındıklı and Güneysu districts) provinces in the northeastern part of Anatolia (East Black Sea region of Turkey). In this region, the Fox grape genotypes grow own-rooted and trellised on pergola in the home backyard or climbed up on redwood trees in the forests and on buildings. Studied vines having foxy taste were ungrafted and own-rooted, derived by an open pollination over hundred years or propagated by cutting. The cultivated Fox grape genotypes grown in coastal as well as in interior part of the region were marked first; then 18 genotypes were described having notably different pomological and phenological characters.

Rize is the rainiest province of Turkey with 2,174 mm rainfall. It has 255-day growing period, 14.1°C average temperature and 1,780 degree days of effective heat summation. Compared to that, the length of growing period in Artvin is 232 days, the effective heat summation is 1,734 degree days, while the average temperature is 13.1°C and rainfall is 965.3 mm (ÇELİK et al. 1998).

Morphological characters of the studied Fox grape genotypes were observed from bud break to leaf fall

Table 1. List of the studied plant materials

Province	District	Genotype
Artvin (08)	Arhavi	08 Arhavi 01, 08 Arhavi 02, 08 Arhavi 03
	Hopa	08 Hopa 01
Rize (53)	Centre	53 Centre 01, 53 Centre 02, 53 Centre 03, 53 Centre 04, 53 Centre 05, 53 Centre 06
	Ardeşen	53 Ardeşen 01, 53 Ardeşen 02
	Fındıklı	53 Fındıklı 01
	Pazar	53 Pazar 01, 53 Pazar 02, 53 Pazar 03,
	Güneysu	53 Güneysu 03, 53 Güneysu 05

stage from 2001 to 2004. Table 1 presents the list of the provinces, districts and genotypes studied. Morphological descriptions were made according to the "Descriptor List for Grape" (ANONYMOUS 1997). The ampelographic characters are listed in Table 2. In total, 18 Fox grape genotypes were investigated. In ampelographic description, young leaf, young shoot, mature leaf, woody shoot, inflorescence, bunch, berry and seed of Fox grape genotypes were examined. Scale values prepared by KARA (1990) were used for evaluation of visual characters. The mature leaf size was determined by using the equation of UZUN and ÇELİK (1999). The main parameters of the must were analyzed at harvest. Genotypes chosen from the provinces were labeled as province number (08 for Artvin and 53 for Rize), district name and genotype number (Table 1).

## RESULTS AND DISCUSSION

Average values of the qualitative parameters of 18 Fox grape genotypes are given in Table 3. Most of the genotypes were classified as half-open or closed young shoot tip form, 53 Centre 06, 53 Pazar 02 and 53 Güneysu 03 genotypes have an open form of young shoot tip. Distribution of anthocyanin coloration of young shoot tip showed a difference among the *labrusca* genotypes; three of them (53 Centre 03, 53 Centre 05 and 53 Güneysu 03) had overall tip coloration. The intensity of anthocyanin coloration of tip was classified as absent, weak, very weak and strong (53 Centre 05 and 53 Güneysu 05). Growth of axillary shoot of the genotypes was very weak, weak or medium; however, 53 Centre 02 and 53 Centre 04 genotypes produced strong axillary shoots. It was observed that tendrils in all the *labrusca* genotypes distributed continuously along with the shoot except for 53 Centre 02 and 53 Pazar 02 showed discontinuous tendril distribution. Mature leaf size was medium, large or very large. It was observed that the mature leaf area calculated via UZÇELİK-I mathematical model (UZUN, ÇELİK, 1999; ÇELİK, UZUN 2002) changed between  $153.3 \pm 10.2$  (53 Pazar 01) and  $324.6 \pm 39.5$  (53 Fındıklı 01) (Table 4). On the other hand, the shape of blade was mostly wedging (8 types), 53 Ardeşen 02 had however a cordate blade shape and some others had circular, pentagonal or reniform leaf blade. Thirteen genotypes had entire leaf while the others had three lobes. Mature leaves mostly showed slightly, wide or very wide open petiole sinuses, while 53 Pazar 03 had closed petiole sinuses. The shape of base of petiole sinuses was U-shaped (5 genotypes) or V-shaped (13 genotypes) and it had no particulari-

ties. On lower surfaces of mature leaves, 12 genotypes had very dense prostrate hairs between veins but this density was medium on 53 Ardeşen 01 (Table 3). The length of internodium changed between  $7.4 \pm 0.8$  (08 Hopa 01) and  $19.5 \pm 0.9$  (53 Centre 05). All Fox grape genotypes had hermaphrodite flower type, and each shoot generally had 2–3 or more than 3 inflorescences. Number of bunch per shoot was mostly 2 or 3 (14 genotypes), three genotypes had more than 3 bunches, however 53 Ardeşen 01 genotype had 1 or 2 bunches per shoot. Bunch size, calculated by bunch length and width, was between  $41.8 \pm 7.8$  (53 Centre 05) and  $125.7 \pm 12.3$  (08 Arhavi 02) and was classified as small, medium, large or very large (Tables 3 and 4). Number of berries per bunch was classified as very few or few and it ranged between  $14.7 \pm 2.2$  (53 Centre 05) and  $71.3 \pm 6.5$  (53 Centre 06). Single bunch weight was low or very low and it was between  $58.3 \pm 11.9$  g. (53 Ardeşen 02) and  $186.8 \pm 32.2$  g. (53 Centre 06). Berry size was medium (3 genotypes) or large (15 genotypes); 53 Güneysu 05 genotype had the smallest berries (1.499 g.) while 53 Centre 05 had the largest (5.282 g.) ones. Berry skin color was rose, blue-black, red-black or red-grey. However, 53 Centre 06 genotype had green-yellow berry skin color. Nearly all genotypes had no flesh color except for 53 Fındıklı 01, which had medium-colored flesh. All genotypes marked as having juicy flesh gave medium or high must yield and they had particular foxy flavor as a dominant character of *Vitis labrusca* grape species. Percentage of berry set was between  $11.9 \pm 1.9\%$  (53 Centre 05) and  $78.4 \pm 3.7\%$  (53 Centre 02) (Table 4). Percentage of total-soluble-solids changed between 12.0% (08 Hopa 01) and 22.2% (53 Pazar 03), and was classified as very low, low, medium or high. The time of ripening was generally very late but 53 Centre 06 and 53 Güneysu 05 matured late in season. All genotypes had at least 2 seeds and their weight was high or very high (Table 3).

Qualitative parameters of Fox grapes showed strict differences. Form of shoot tip was mostly closed as stated by CANGI et al. (2006a), MELEK and ÇELİK (2005) and ŞANLI and ODABAŞ (2005), but several types had open shoot tip similar to the findings of KARA (1990). It was found that shoot tip coloration, which is an important character for distinguishing the grape cultivars (MORTON 1979), differed among genotypes. Twelve genotypes had different color intensity while two of them showed strong coloration. On the other hand, six genotypes had no anthocyanin coloration. According to IBPGR (ANONYMOUS 1997) *labrusca* grapes have very strong anthocyanin coloration on young shoot tip. Moreover, this character may vary in relation to light (KARA 1990). Hairiness

Table 2. Descriptor list for grapevines (ANONYMOUS 1997)

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<b>Young shoot</b>	Code No : OIV 001	Form of tip
	Code No : OIV 002	Distribution of anthocyanin colouration of tip
	Code No : OIV 003	Intensity of anthocyanin colouration of tip
	Code No : OIV 004	Density of prostrate hairs of tip
<b>Young leaf</b>	Code No : OIV 053	Density of prostrate hairs between veins
	Code No : OIV 054	Density of erect hairs between veins
	Code No : OIV 055	Density of prostrate hairs on primary veins
	Code No : OIV 056	Density of erect hairs on primary veins
<b>Shoot</b>	Code No : OIV 007	Colour of dorsal side of internodes
	Code No : OIV 008	Colour of ventral side of internodes
	Code No : OIV 009	Colour of dorsal side of nodes
	Code No : OIV 010	Colour of ventral side of nodes
	Code No : OIV 011	Density of erect hairs of the nodes
	Code No : OIV 012	Density of erect hairs on internodes
	Code No : OIV 013	Density of prostrate hairs on nodes
	Code No : OIV 014	Density of prostrate hairs on the internodes
	Code No : OIV 352	Growth of axillary shoot
<b>Tendrils</b>	Code No : OIV 016	Distribution on the shoot
	Code No : OIV 017	Length
<b>Mature leaf</b>	Code No : OIV 065	Size
	Code No : OIV 067	Shape of blade
	Code No : OIV 068	Number of lobes
	Code No : OIV 071	Anthocyanin colouration of primary veins on lower surface of blade
	Code No : OIV 076	Shape of teeth
	Code No : OIV 078	Length of teeth compared with their width at the end of the base
	Code No : OIV 079	General shape of petiole sinus
	Code No : OIV 080	Shape of base of petiole sinus
	Code No : OIV 081	Particularities of petiole sinus
	Code No : OIV 082	Shape of upper leaf sinuses
	Code No : OIV 084	Density of prostrate hairs between veins (lower surface)
	Code No : OIV 087	Erect hairs on primary veins (lower surface)
	Code No : OIV 088	Prostrate hairs on primary veins (upper surface)
	Code No : OIV 089	Erect hairs on primary veins (upper surface)
	Code No : OIV 090	Density of prostrate hairs on petiole
	Code No : OIV 091	Density of erect hairs on petiole
<b>Inflorescence</b>	Code No : OIV 151	Sex of flower
<b>Bunch</b>	Code No : OIV 201	Number of bunch per shoot
	Code No : OIV 202	Bunch size
	Code No : OIV 203	Bunch length
	Code No : OIV 204	Bunch density
	Code No : OIV 205	Number of berries
	Code No : OIV 206	Length of peduncle
	Code No : OIV 207	Lignification of peduncle
	Code No : OIV 501	Percentage of berry set
	Code No : OIV 502	Single bunch weight
<b>Berry</b>	Code No : OIV 220	Size
	Code No : OIV 222	Uniformity of size
	Code No : OIV 223	Shape
	Code No : OIV 224	Cross section
	Code No : OIV 225	Colour of skin (without bloom)
	Code No : OIV 230	Colour of flesh
	Code No : OIV 232	Juiciness of flesh
	Code No : OIV 233	Must yield
	Code No : OIV 236	Particular flavour
	Code No : OIV 304	Physiological stage of full maturity of the berry
	Code No : OIV 503	Single berry weight
	Code No : OIV 505	Sugar content of must
	Code No : OIV 506	Total acid content of must
<b>Seed</b>	Code No : OIV 241	Presence of seed
	Code No : OIV 243	Weight per seed
	Code No : OIV 244	Transversal ridges on side

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Table 3. Average values of the qualitative parameters of the young shoot (OIV: 001, 002, 003 and 004), young leaf (OIV: 053, 054, 055 and 056), shoot (OIV: 007, 008, 009, 010, 011, 012, 013, 014 and 352), tendrils (OIV: 016 and 017), mature leaf (OIV: 065, 067, 068, 071, 076, 078, 079, 080, 081, 082, 084, 087, 088, 089, 090 and 091), inflorescence (OIV: 151), bunch (OIV: 201, 202, 203, 204, 205, 206, 207, 501 and 502), berry (OIV: 220, 222, 223, 224, 225, 230, 233, 236, 304, 503, 505 and 506) and seed (OIV: 241, 243 and 244) of different Fox grape genotypes collected from the Northeastern part of Turkey

Code No	Fox grape genotypes																	
	08 Arhavi 01	08 Arhavi 02	08 Arhavi 03	08 Hopa 01	53 Centre 01	53 Centre 02	53 Centre 03	53 Centre 04	53 Centre 05	53 Centre 06	53 Ardesen 01	53 Ardesen 02	53 Findikli 01	53 Pazar 01	53 Pazar 02	53 Pazar 03	53 Guneysu 03	53 Guneysu 05
OIV 001	5	5	3	3	3	5	3	3	3	7	3	5	5	5	7	5	7	5
OIV 002	3	3	1	1	1	3	1	1	5	5	3	3	3	1	3	1	5	3
OIV 003	7	3	3	1	1	5	1	1	9	7	3	3	3	1	5	1	9	5
OIV 004	1	1	1	1	1	1	3	3	7	9	1	1	1	1	1	1	11	9
OIV 053	3	3	3	1	1	3	3	3	1	3	3	3	3	3	3	3	3	5
OIV 054	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 055	1	1	1	1	1	1	3	3	1	3	1	3	3	1	1	1	1	1
OIV 056	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 007	1	2	1	2	2	1	2	2	2	2	1	2	2	1	2	2	2	2
OIV 008	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 009	1	1	1	2	3	1	1	2	1	1	1	2	2	1	1	1	3	2
OIV 010	1	1	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	1
OIV 011	1	1	3	3	1	1	1	1	1	3	1	1	1	1	1	1	1	1
OIV 012	3	3	3	3	3	1	3	3	3	5	3	3	3	3	3	3	3	5
OIV 013	3	3	3	1	3	1	1	1	1	5	1	1	1	1	3	3	5	1
OIV 014	3	3	3	3	3	1	3	3	3	7	1	3	3	3	3	3	7	3
OIV 352	11	9	9	7	5	11	9	7	11	5	5	9	9	7	11	7	7	11
OIV 016	2	2	2	2	2	1	2	2	2	1	2	2	2	2	1	2	2	2
OIV 017	5	7	3	3	1	1	3	1	5	5	5	3	3	1	3	5	5	3
OIV 065	7	5	7	7	5	9	5	7	9	7	5	5	9	5	7	9	9	9
OIV 067	4	2	2	3	2	5	2	2	4	3	2	1	2	4	3	2	5	5
OIV 068	1	1	1	2	1	1	1	1	1	2	1	2	2	1	2	1	1	1
OIV 071	1	5	1	1	1	1	1	1	5	11	1	1	1	1	7	7	3	5
OIV 076	4	4	3	3	3	4	3	3	4	4	3	3	3	4	3	3	4	3
OIV 078	5	3	3	3	3	5	3	3	3	3	3	3	3	3	3	3	9	5
OIV 079	3	4	4	3	4	1	3	3	2	2	3	2	1	3	4	5	2	4
OIV 080	2	1	2	2	2	1	2	2	1	2	2	1	2	2	2	2	1	2
OIV 081	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1
OIV 082	3	3	3	3	3	3	3	3	3	2	3	1	2	3	2	3	2	3
OIV 084	11	11	11	9	11	9	11	9	11	11	7	9	11	9	3	11	11	11
OIV 087	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 088	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1
OIV 089	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 090	7	3	1	5	3	3	1	3	3	5	1	3	3	5	1	3	1	5
OIV 091	1	3	3	1	3	3	3	3	1	1	1	1	1	5	1	1	1	1
OIV 151	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
OIV 201	3	3	3	4	3	4	3	4	3	3	2	3	3	3	3	3	3	3
OIV 202	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
OIV 203	3	3	3	3	1	1	1	3	1	3	1	1	1	3	3	3	3	3
OIV 204	5	5	5	5	5	9	5	5	1	7	5	3	5	5	7	3	7	5
OIV 205	3	3	1	1	1	3	1	1	1	3	1	1	1	1	3	1	3	1
OIV 206	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	5	1	3
OIV 207	1	3	1	1	1	3	3	2	2	2	1	1	2	1	3	2	1	1
OIV 501	3	3	3	5	5	7	3	3	3	7	5	3	3	3	3	3	5	3
OIV 502	3	3	3	3	1	1	1	1	1	3	1	1	1	3	3	3	1	3
OIV 220	7	7	7	7	7	5	7	7	7	7	7	5	7	7	7	5	7	7
OIV 222	1	1	1	2	1	2	1	2	1	1	1	1	1	1	2	1	2	2
OIV 223	3	2	2	8	3	6	2	3	3	3	3	3	3	2	8	3	2	3
OIV 224	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2
OIV 225	2	3	6	6	7	6	6	7	6	1	6	4	2	6	7	2	6	6
OIV 230	1	1	1	1	1	1	1	1	1	1	1	1	7	1	1	1	1	1
OIV 233	5	5	7	7	7	5	7	7	7	7	5	7	7	7	7	7	7	7
OIV 236	3	3	3	3	3	1	3	3	3	3	3	3	3	3	2	3	3	3
OIV 304	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	7
OIV 503	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	3
OIV 505	3	5	3	1	3	7	3	5	3	3	3	5	3	3	5	7	1	5
OIV 506	9	7	3	5	3	3	3	5	3	3	3	5	7	5	5	5	3	3
OIV 241	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
OIV 243	7	7	7	9	7	7	7	7	7	7	7	7	7	7	7	7	9	5
OIV 244	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

is an important character for grape leaves. Most of the genotypes had no or very sparse erect or prostrate hair on young leaves. Growth of axillary shoot was weak or strong due to its semi-erect, horizontal or dropping shoot habit (KARA 1990; MELEK, ÇELİK

2005; ŞANLI, ODABAS 2005; CANGI et al. 2006b). Tendrils were distributed continuously on fifteen grape genotypes, three types had sub-continuous tendrils. There is a good explanation by ÇELİK et al. (1998) reporting that *labrusca* × *riparia* × *vinifera* hybrids

Table 4. Average values and standard deviation of the quantitative parameters measured in shoots, leaves, inflorescence, clusters, berries and seeds of the Fox grape genotypes grown in Northeastern part of Anatolia

Traits	Fox grape genotypes																										
	08 Arhavi		08 Arhavi		08 Hopa		53 Centre		53 Centre		53 Centre		53 Ardesen		53 Ardesen		53 Findikli		53 Pazar		53 Pazar		53 Guneysu		53 Guneysu		
01	02	03	01	02	03	01	02	03	04	05	06	01	02	01	02	01	02	01	02	03	04	05	03	04	05	03	05
Leaf width (cm) (A)	18.2±1.1*	17.6±0.9	16.5±1.4	16.7±1.5	14.1±0.7	20.0±1.5	15.5±1.5	15.6±1.1	18.7±0.9	17.5±1.2	14.6±1.2	14.6±1.3	20.8±1.2	13.4±0.7	16.7±0.6	21.2±1.2	18.2±0.9	20.4±0.4									
Leaf length (cm) (B)	17.2±1.1	15.6±0.7	15.1±1.0	15.2±1.1	12.8±0.7	20.1±1.2	14.1±1.4	15.1±1.3	18.3±1.0	15.6±0.7	12.7±0.9	14.1±1.1	20.8±1.6	12.7±0.7	15.4±0.4	20.6±1.3	17.7±1.3	17.5±0.6									
Leaf size (A × B)	314.5±39.2	276.5±24.2	251.3±34.4	256.6±36.1	181.1±17.2	406.7±50.7	224.3±48.7	239.1±37.3	344.7±34.2	273.5±25.5	186.9±27.3	209.3±32.4	437.3±57.0	171.1±16.1	257.1±12.5	439.0±51.3	324.1±38.4	355.9±13.6									
Leaf area (cm <sup>2</sup> )*	240.7±24.2	217.0±14.2	202.7±22.2	205.8±23.8	161.5±10.8	302.2±33.2	187.0±30.3	195.5±23.3	261.7±21.8	215.4±15.5	166.6±16.4	175.4±19.8	324.6±39.5	153.3±10.2	205.3±7.5	320.6±32.0	249.3±26.4	263.3±7.3									
Midvein length (cm) (C)	13.3±0.8	13.5±0.6	12.5±0.8	12.8±0.9	10.6±0.6	15.7±1.2	12.0±0.9	12.0±0.7	15.1±1.0	14.3±0.6	11.4±0.9	11.50±0.9	16.1±0.9	10.4±0.7	12.1±0.6	15.4±0.8	15.9±0.9	14.1±0.2									
Petiole length (cm) (D)	10.4±0.7	13.5±1.0	9.9±1.0	9.7±0.9	6.1±0.9	10.1±1.1	8.3±1.1	8.2±0.9	10.9±0.9	6.7±1.0	6.6±0.6	10.4±1.1	12.8±1.1	7.2±1.0	13.8±1.4	12.8±0.7	10.8±0.6	9.1±0.2									
D/C	0.8±0.0	1.0±0.1	0.8±0.1	0.8±0.1	0.6±0.1	0.6±0.1	0.7±0.1	0.7±0.1	0.7±0.1	0.5±0.1	0.6±0.1	0.9±0.1	0.8±0.1	0.7±0.1	1.1±0.1	0.8±0.1	1.5±0.1	1.5±0.1									
Teeth length (mm) (E)	3.1±1.0	2.2±0.6	3.2±1.1	3.1±1.0	1.9±0.5	3.4±0.7	1.9±0.5	2.9±0.6	3.3±0.6	2.2±0.2	2.2±0.7	2.0±0.5	2.4±0.6	1.6±0.6	2.7±0.8	2.7±1.1	7.6±0.3	8.2±0.2									
Teeth width (mm) (F)	6.6±1.5	5.9±1.2	9.3±1.7	9.7±1.9	6.3±0.9	7.0±1.1	7.5±1.3	7.5±1.4	7.4±0.9	7.2±0.4	6.6±1.4	6.5±1.2	7.2±1.2	5.6±0.9	6.9±1.0	7.4±1.7	3.8±0.3	16.4±0.8									
E/F	0.5±0.2	0.4±0.1	0.3±0.1	0.3±0.1	0.3±0.1	0.5±0.1	0.3±0.1	0.4±0.1	0.5±0.1	0.3±0.02	0.4±0.2	0.4±0.1	0.4±0.1	0.3±0.1	0.4±0.1	0.4±0.2	2.0±0.2	0.5±0.0									
Peduncle length (cm)	2.3±0.7	5.4±0.8	1.8±0.3	1.8±0.2	1.7±0.3	0.9±0.1	1.3±0.2	1.9±0.3	1.8±0.4	2.8±0.4	1.4±0.3	2.2±0.4	1.7±0.2	1.3±0.3	2.52±0.24	3.9±0.6	2.9±0.2	3.1±0.2									
Bunch length (cm) (G)	12.7±1.3	15.0±1.0	11.4±0.8	11.9±1.1	9.9±0.8	9.5±0.7	9.8±1.0	11.6±0.8	8.3±1.2	12.1±0.8	9.3±1.3	10.5±1.3	8.7±0.9	11.5±0.8	13.2±0.9	13.6±1.0	13.1±0.7	12.2±0.4									
Bunch width (cm) (H)	7.4±1.2	8.3±0.5	6.1±0.9	5.9±0.9	5.0±0.4	4.8±0.4	5.9±0.6	5.6±0.5	4.9±0.6	9.2±0.7	5.5±0.8	5.5±1.0	6.1±0.9	6.5±0.7	6.2±0.9	6.9±0.7	7.3±0.6	8.1±0.2									
Bunch size (G × H)	95.4±20.6	125.7±12.3	70.3±12.6	71.1±14.2	50.1±6.2	45.7±5.1	58.2±11.6	65.2±8.8	41.8±7.8	111.4±11.9	52.4±15.6	59.0±13.2	53.5±13.3	74.3±10.5	82.8±15.4	93.8±12.7	95.0±10.9	99.6±5.0									
Berry (number/bunch) (I)	53.4±6.6	54.7±4.5	40.5±3.1	38.5±4.5	29.4±3.3	54.9±2.3	29.5±5.0	37.4±5.3	14.7±2.2	71.3±6.5	33.2±2.5	22.3±5.0	30.9±4.2	37.7±4.3	52.3±5.3	41.6±4.0	55.6±5.2	48.9±2.3									
Pedicle length (mm)	6.8±0.7	6.9±0.5	6.7±0.9	6.6±0.8	4.7±0.5	5.4±0.5	6.6±0.4	4.4±0.5	5.3±0.5	5.6±0.5	7.5±0.9	5.3±0.7	5.8±0.4	6.1±0.7	5.8±0.8	6.4±0.7	6.3±0.5	7.9±0.1									
Berry length (mm) (J)	17.6±0.8	16.9±0.7	17.8±0.7	18.4±0.8	18.0±0.5	13.6±0.5	17.4±0.8	19.0±0.5	20.0±0.7	18.3±0.3	17.5±1.0	16.1±0.5	18.1±1.1	18.4±0.7	16.7±0.5	16.3±0.7	16.7±0.4	18.6±0.6									
Berry width (mm) (K)	16.9±0.6	16.9±0.3	16.5±0.5	16.5±0.7	16.9±0.5	11.7±0.4	15.8±0.5	17.7±0.8	20.1±0.6	18.0±0.5	16.7±0.8	15.9±0.5	17.2±1.3	16.8±0.6	15.8±0.5	16.0±0.7	16.9±0.6	17.8±0.5									
Berry size (J × K)	298.1±23.2	287.3±15.3	294.5±18.1	303.7±24.5	304.8±15.8	159.7±10.4	274.6±20.5	336.6±21.2	403.7±0.6	330.9±14.0	294.5±29.3	258.1±15.0	313.9±41.8	310.6±22.6	264.1±15.4	262.6±22.4	281.9±15.9	330.8±19.8									
Inflorescence length (cm)	7.3±0.4	7.9±0.5	11.2±0.2	8.5±0.9	5.1±0.3	5.3±0.2	7.2±0.1	6.3±0.1	6.6±0.2	6.6±0.1	7.1±0.1	5.4±0.6	6.4±0.2	5.3±0.4	10.1±0.4	5.8±0.5	13.8±0.5	6.1±0.4									
Inflorescence number (L)	171.0±1.6	166.7±2.2	210.5±4.2	102.6±3.9	64.6±1.4	70.2±1.4	119.9±4.5	150.9±2.6	123.3±5.4	120.3±6.2	89.7±3.6	104.8±6.7	159.3±2.7	123.0±3.1	287.7±4.2	123.6±1.4	149.2±8.5	147.0±9.4									
Tendrill length (cm)	20.2±1.4	24.1±1.2	12.1±0.6	8.4±1.1	9.8±0.6	9.5±0.4	14.9±0.5	8.8±1.1	19.3±0.4	19.1±0.6	19.5±0.7	16.1±0.7	14.1±0.4	8.6±0.7	14.2±0.3	16.7±0.7	20.6±0.9	13.5±0.8									

Table 4 to be continued

Traits	Fox grape genotypes																			
	08		08		08		08		08		08		08		08		08		08	
	Arhavi	01	Arhavi	03	08	01	Centre	02	Centre	03	Centre	04	Centre	05	Centre	06	Ardesen	01	Ardesen	02
Bunch weight (g.)	134.3±23.8	158.1±7.6	114.9±11.5	110.3±13.2	75.0±8.9	61.0±3.4	88.7±12.8	96.2±14.4	69.9±10.3	186.8±32.2	71.8±14.1	58.3±11.9	87.1±9.5	129.5±4.3	138.9±19.3	110.6±13.8	97.9±12.9	150.9±3.4		
Internodium length (cm)	12.9±1.4	18.4±1.9	7.7±0.7	7.4±0.8	13.9±1.5	8.3±0.8	15.8±1.5	15.4±1.1	19.5±0.9	16.9±1.3	11.6±2.2	16.2±1.7	16.6±2.5	10.3±0.9	11.5±3.3	17.4±1.2	10.9±1.1	13.4±2.3		
Internodium diameter (mm)	8.0±0.4	8.5±0.6	4.3±0.2	4.4±0.2	6.0±0.4	6.4±0.4	7.1±0.3	8.6±0.8	7.1±0.5	10.6±0.8	8.6±1.2	7.1±0.6	7.9±0.8	8.1±0.7	7.5±0.6	8.1±0.9	6.7±0.6	5.9±0.5		
Berry set (%) (1 × 100/L)	31.3±3.9	32.9±2.8	19.3±1.7	37.6±4.4	45.4±4.8	78.4±3.7	24.5±3.7	24.8±3.5	11.9±1.9	59.3±3.6	37.0±2.3	21.3±4.9	19.4±2.7	30.8±3.7	18.2±1.8	33.7±3.3	37.6±4.5	33.5±1.9		
Seed weight (g/100 seed)	5.8	5.9	5.7	6.8	5.8	4.9	5.4	5.8	5.3	4.9	5.4	5.1	5.5	6.1	6.1	5.5	6.9	4.7		
Must yield (ml/100 g)	64.0	62.0	65.0	65.0	69.0	63.0	68.0	68.0	72.0	67.0	63.0	68.0	68.0	70.0	69.0	68.0	72.0	65.0		
100 berry weight (g)	353.9	301.1	267.2	336.2	270.0	139.0	309.2	346.0	528.2	364.8	286.2	303.6	264.7	324.7	272.6	298.5	297.6	149.9		
TSS (%)	16.8	17.6	14.5	12.0	13.2	19.4	15.4	17.3	14.8	14.3	16.2	17.4	15.0	14.3	19.0	22.2	12.2	19.4		
Titrate acidity (g/100 cc)	13.9	11.6	7.8	8.9	7.5	7.6	6.8	9.3	6.3	3.4	7.4	10.7	12.3	7.6	9.4	9.6	5.0	3.4		

\*All values given after (±) represent standard deviation (SD)

could show sub-continuous tendril distribution while *labrusca* and Concord have continuous tendril distribution on the shoot. Leaf size and leaf shape strongly differed among cultivars as well. Fifteen genotypes had entire leaf and three had lobbed leaves. KARA (1990), ŞANLI and ODABAŞ (2005) and MELEK and ÇELİK (2005) reported that the native Fox grapes may have entire or lobbed leaves. On the other hand, *Vitis labrusca* and its genotypes are known to have large, thick and almost entire leaf (ANTCLIFF 1997). The size of mature leaf was determined as medium, large or very large. MORTON (1979) noted that the size of blade changed according to soil fertility, vigor, training system and ecology. ORAMAN (1972) also stated that vineyard location, clone and orientation of the shoots affect the petiole size. In mature leaves, there were dense or very dense prostrate hairs between veins as stated by WINKLER et al. (1974) and ÇELİK et al. (1998). Similar to some other studies on *labrusca* grapes (KARA 1990; MELEK, ÇELİK 2005; ŞANLI, ODABAŞ 2005; CANGI et al. 2006a), the sexes of the flowers were hermaphrodite in all assessed genotypes. The bunch size of all the genotypes was very small. Six genotypes had very few berries (< 51), while twelve had few berries (88–112). According to BONNER (1995), Fox grape *Vitis labrusca* have fewer than 20 globose berries. However, most of the investigated Fox grape genotypes had more than 20 and less than 50 berries. Bunch and berry size may be affected with soil type, fertilizing, fall irrigation, berry set, blossoming, plant growth regulators and climatic conditions (MORTON 1979). The results concerned with the bunch were similar to the findings of MELEK and ÇELİK (2005) and CANGI et al. (2006a,b). The shape of bunch was cylindrical or conic and winged. Berry size was described as medium to large while its shape was round. The skin color of the genotypes was dark red-violet, red-grey or blue-black; and the flesh had no color. These characters correspond to the previous studies done by KARA (1990), MELEK and ÇELİK (2005), ŞANLI and ODABAŞ (2005) and CANGI et al. (2006a,b). The particular flavor of all genotypes was foxy as a typical character of *Vitis labrusca* species. The time of ripening was generally very late. Researches stated that the time of ripening was affected by the number of bunch, cultivar, pruning, altitude, irrigation, fertilizing and effective heat summation (ORAMAN 1972; WINKLER et al. 1974; WEAVER 1976). MELEK

and ÇELİK (2005) and ŞANLI and ODABAŞ (2005) also stated that Fox grapes grown in temperate regions ripened late.

In conclusion, ampelography is a scientific branch engaged in differentiation and identification of grapevine varieties. As varietal confusions continuously occur, the efforts in developing an identification procedure are increasing. Today we can successfully use the easiest way, i.e. morphological characteristics. Within the presented study eighteen grapevine types having foxy taste were described. All Fox grape genotypes were found to be promising for *labrusca* viticulture in the Eastern coastal region of Turkey with high rainfall, humidity and acidic soils. The identified *labrusca* grapevines are to be used as a genetic resource in further studies on resistance of fungal diseases and in breeding programs.

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## Určování genotypů révy americké (*Vitis labrusca* L.) pěstované v severovýchodní Anatolii

**ABSTRAKT:** Severovýchodní Anatolie je genetickým centrem vinařství a vykazuje velkou diverzitu révy americké. Vinařství a některé druhy rév v černomořské oblasti (sever Turecka) jsou na pokraji vyhynutí; některé typy a druhy rév v této oblasti nebyly nikdy popsány a nezachovaly se do dnešní doby. Během uplynulých deseti let jsme studovali vinice a druhy rév v této oblasti. V práci je popsáno 18 rév s chutí specifickou pro divokou americkou révu, pěstovaných v Artvin a Rize. Ampelografický popis mladých a zralých výhonů a listů, hroznů a semen byl proveden s použitím seznamu kultivarů a druhů rév podle OIV (Office International de la Vigne et du Vin). Pro popis kultivarů však byly hodnoceny i některé další parametry.

**Klíčová slova:** réva americká (*Vitis labrusca* L.); popis; OIV; UPOV; Turecko

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