

Palynological Study on the Pollen Grains of Selected Turkish Grape (*Vitis vinifera* L.) Cultivars

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Abstract: The pollen morphology and ultrastructure of selected Turkish indigenous grape cultivars and newly released hybrid varieties were examined by light microscopy and scanning electron microscopy. The pollen differed in some microstructural parameters. The size of the pollen grains ranged from 19.0 x 22.4 µm in Beyaz Çavuş to 24.3 x 21.0 µm in Siyah Gemre. Hönüsü cultivar showed significant variations in the sizes of the polar and equatorial axes. The greatest colpus size was measured in Siyah Gemre (18.4 µm) and the longest pore size was observed in Ata sarısı (28 µm). The exine thickness of the pollen grains ranged from 0.5 to 1.8 µm in the equatorial axis from and 0.6 to 1.4 µm in the polar axis. Subprolate and prolate-spheroidal shapes were determined in the tricolporate pollen grains and suboblatial and spheroidal shapes in the inaperturate pollen grains. A reticulate ornamentation in the apocolpium regions was a distinctive characteristic in the cultivars examined.

Key Words: Pollen, pollen morphology, *Vitis vinifera* L., grape cultivars

Bazı Türk Üzüm Çeşitlerinin (*Vitis vinifera* L.) Polenleri Üzerinde Palinolojik bir Çalışma

Özet: Türkiye'nin yerli üzüm çeşitleri ve hibritlerinin polen morfolojileri ışık ve taramalı elektron mikroskoplarında incelendi. Bazı mikro yapı parametrelerinde polenlerin farklı olduğu görüldü. Polen boyutları 19.0 x 22.4 µm (Beyaz Çavuş) dan 24.3 x 21.0 µm (Siyah Gemre) e kadar değişmektedir. Hönüsü çeşitleri polar ve ekvatorial ölçümler bakımından büyük varyasyonlar göstermektedir. En büyük kolpus uzunluğu Siyah Gemre' de (18.4 µm) ölçüldü ve en uzun por Ata Sarısı'nda (28 µm) gözlemlendi. Ekzin kalınlıkları ekvatorial ekseninde 0.5-1.8 µm ve polar ekseninde 0.6-1.4 µm arasında değişmektedir. Trikolporate polende subprolate ve prolate-spheroidal şekil ve inaperturate polende subprolate ve prolate-spheroidal polen şekli tanımlandı. Apokolpium bölgesinde görülen retikulate ornamentasyon kontrol edilen kültürlerde belirgin karakterdedir.

Anahtar Sözcükler: Polen, polen morfolojisi, *Vitis vinifera* L., üzüm çeşitleri

Introduction

As is proposed in the literature, palynology has presented considerable opportunities for cultivar identification in grapevines, besides its importance in plant taxonomy. Ahmedullah (1983) stated that the pollen of each cultivar has a unique pattern when the measurements of pollen grains polar axis, equatorial diameter, P/E ratio and exine patterns are considered together. According to Roytchev et al. (1994) and Roytchev (1995), biometric analysis of the elements of the pollen aperture complex may be used as microstructural criteria for cultivar identification in grapevines.

There are very few palynological studies on the Turkish grape germplasm. In the scanning electron microscopy (SEM) study by Uzun and İter (1987), among the pollens investigated, which belonged to the collection of the Geilweilerhof Institute, only 2 of them were well-known Turkish grape cultivars (Beylerce, Çavuş and Hacı-tespihi). On the other hand, İnceoğlu et al. (2000) made observations on the ultrastructure of pollen samples in *Vitis sylvestris* Gmelin, which was collected from northern Anatolian and stored in the herbarium of Ankara University.

Therefore, the objective of this study was to investigate in detail the pollen morphology and ultrastructure of newly released grape hybrids and

selected native grape cultivars that are frequently used as parent plants in crossbreeding studies in Turkey, by light microscopy (LM) and scanning electron microscopy (SEM).

Materials and Methods

The investigations were carried out with pollen from Ata sarısı, Uslu and Yalova incisi (new Turkish hybrids), and Siyah Gemre, Beyaz Çavuş, Karagevrek, Hönüsü and Tahannebi (indigenous cultivars) plants located at the Viticultural Research Station of Ankara University in Kalecik district in Ankara province. The flower clusters were isolated and the pollen grains were gathered after these flower clusters were harvested at the beginning of the blooming period.

The Woodhouse method was followed for the LM study. The descriptions of the pollen grains with a Leitz-Wetzlar microscope (16 x 100) were based on morphological observations, including shape (symmetry and polarity), size, aperture (type, number and arrangement) and exine sculpturing. The polar (P) and equatorial (E) axes and the P/E relationship were determined according to Simpson and Roe in Van der Pluym and Hideux (1977).

In the SEM studies, the pollen grains taken from the anther were placed directly on stubs and were covered with gold. The detailed surface ornamentation and the aperture characteristics were examined with a scanning electron microscope and microphotographs were taken.

The terminologies of Erdman (1952), Faegri and Iversen (1989) and Kuprijanova and Alashina (1967) were used in the morphological descriptions of the pollen.

Results

Given the great homogeneity of the characteristics of the taxa, a general description was established for all, according to the values of the various parameters corresponding to the maxima and minima records of the cultivars. Details for each taxon are given in Table 1 and Figure 1, by applying the graphical test described by Simpson and Roe.

Size: The size of the pollen grains (polar axis x equatorial axis) of the tested cultivars ranged from 19.0 x 22.4 µm in Beyaz Çavuş to 24.3 x 21.0 µm in Siyah Gemre. There is a slight variation in the size of the pollen grains. Yalova İncisi, Ata sarısı, Uslu and Tahannebi have pollen grains similar in size (Table 1 and Figures 1,2). Hönüsü showed a significant variation in the sizes of the polar and equatorial axes (Figures 1,2).

Symmetry and shape: The pollen grains were apolar (Hönüsü, Beyaz Çavuş and Karagevrek), isopolar (Siyah Gemre, Uslu, Yalova incisi, Ata sarısı and Tahannebi), bilateral symmetrical (Hönüsü, Beyaz Çavuş and Karagevrek), radially symmetrical (Siyah Gemre, Uslu, Yalova incisi, Ata sarısı and Tahannebi) and suboblatial, subprotial, spheroidal and prolate-spheroidal (Figure 3). The ratio of P to E is 0.84-1.16. The outline is rectangular in the equatorial optical section and triangular in the meridional optical section (Figures 4-6).

Apertures: Typically 2 aperture types were observed. Tricolporate pollen grains were observed in cultivars of Siyah Gemre, Uslu, Yalova İncisi, Ata sarısı and Tahannebi, whereas Hönüsü, Beyaz Çavuş and Karagevrek were inaperturate. The ora were elliptic or quite circular in all of the cultivars. The greatest colpus

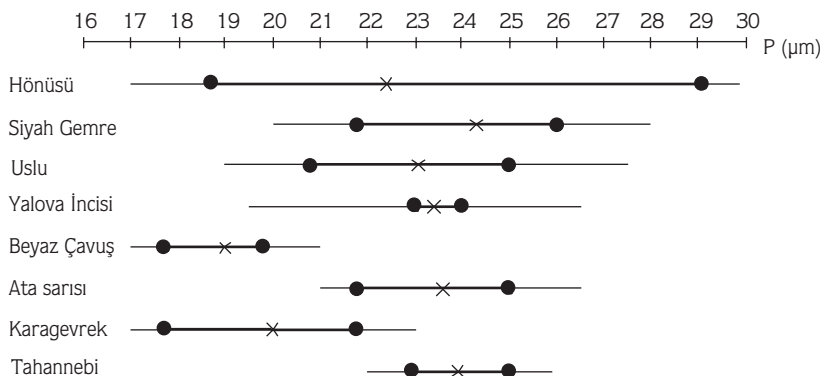


Figure 1. Simpson and Roe test for P (polar axis).

Table 1. Morphological characteristic of pollen of grape cultivars (mm).

Cultivars	Mean Pollen Size															
	Polar axis (P)	Sd	Equatorial axis (E)	Sd	P/E ratio	Aperture type	Length of the colpus	Width of the colpus	Pore length	Pore width	Equatorial exine	Polar exine	Equatorial intine	Polar intine	Ornamentation mesocolpium	Ornamentation apocolpium
Hönüsü	22.4	2.4	26.7	2.02	0.84 (suboblate)	Inaperturate	-	-	-	-	1	1	0.6	0.6	Reticulate	-
Siyah Cemre	24.3	1.98	21	1.5	1.16 (suboblate)	Tricolporate	18.4	0.9	2.1	2.1	1.8	1	0.4	0.5	Perforated-	Reticulate
Uslu	23.1	2.7	20.4	1.7	1.13 (prolate-spheroidal)	Tricolporate	15.1	0.5	2.1	2.1	0.5	0.9	1.1	1	Perforated-rugulate	Reticulate
Yalova Incisi	23.4	2.24	20.8	3.03	1.13 (prolate-spheroidal)	Tricolporate	16.3	0.5	2.3	2.3	0.8	1.3	1	0.7	Retiplate	Reticulate
Beyaz Cavuş	19	2.01	22.4	1.34	0.84 (suboblate)	Inaperturate	-	-	-	-	1.2	1.2	0.3	0.3	Reticulate	-
Ata sarısı	23.6	1.03	21.7	1.1	1.09 (prolate-spheroidal)	Tricolporate	16.6	0.9	2.8	2	1.7	1.4	0.5	0.3	Foveolate	Reticulate
Karagevrek	20	3.35	20.7	2.7	0.97 (spheroidal)	Inaperturate	-	-	-	-	0.8	0.8	0.3	0.3	Reticulate	-
Tahannebi	23.9	2.58	22	2.3	1.09 (prolate-spheroidal)	Tricolporate	15.6	1.4	2.6	2.6	1	0.8	0.7	1	Foveolate	Reticulate

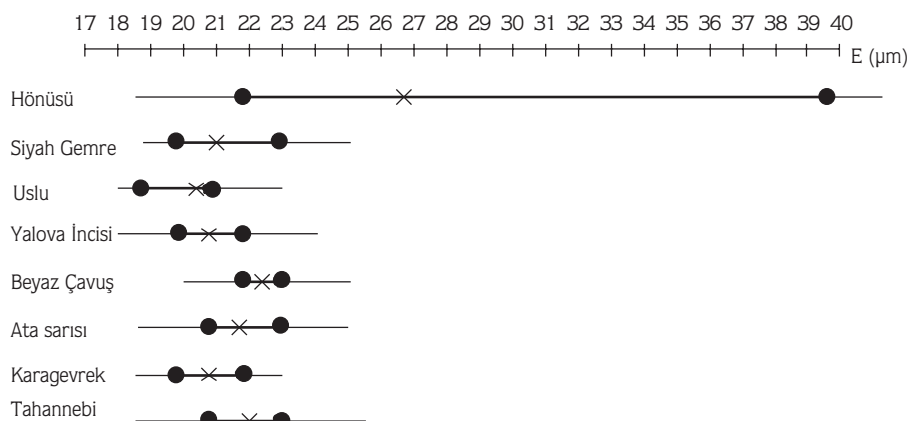


Figure 2. Simpson and Roe test for E (equatorial axes).

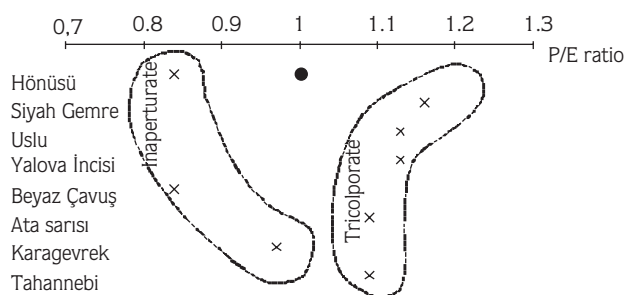


Figure 3. Mean value for P/E ratio.

size was measured in Siyah Gemre (18.4 µm) and the longest pore size was observed in Ata sarısı (28 µm). The mean values for colpus and pore sizes showed little variation among the cultivars (Table 1 and Figures 4-6).

Exine - Intine: The exine thickness of the pollen grains ranged from 0.5-1.8 µm in the equatorial axis and 0.6-1.4 µm in the polar axis. The Siyah Gemre and Ata sarısı had the thickest exine. The tectum was subtectate. The exine was thicker than the endexine. The exine was the same thickness at the equatorial axis and polar axis in inaperturate pollen. The equatorial axis was thicker than the polar axis in Siyah Gemre, Ata sarısı and Tahannebi, but the polar axis was thicker than the equatorial axis in Uslu and Yalova incisi. The pollen wall under SEM showed reticulate, perforated-rugulated and foveolate sculpturing at the mesocolpium, irregular, almost circular to oblong perforations with a diameter of 0.1 µm to 2.0 µm and distinctly reticulate towards the poles and at the poles (Figures 4-6). The intine was thicker than the exine in Uslu.

Discussion

The findings obtained by electron microscope in this study showed that the pollen morphological characteristics for the *Vinifera* cultivars can be used as a distinctive characteristic. The results given below were derived from the graphs obtained with the application of the Simpson and Roe test for the P, E and P/E values of the cultivars.

A certain homogeneity for P and E values was observed (Figures 1,2). Generally, the P and E values measured within the same cultivar showed a change within a very small range. It was determined that the Hönüsü cultivar displayed great variations in the P and E values (Figures 1,2). The P/E ratio was 1.09-1.16 in the tricolporate pollen grains and 0.84-0.97 in the inaperturate pollen grains (Figure 3). Subprolate and prolate-spheroidal shapes were determined in the tricolporate pollen grains and suboblatial and spheroidal in the inaperturate pollen grains. Ahmedullah (1983)

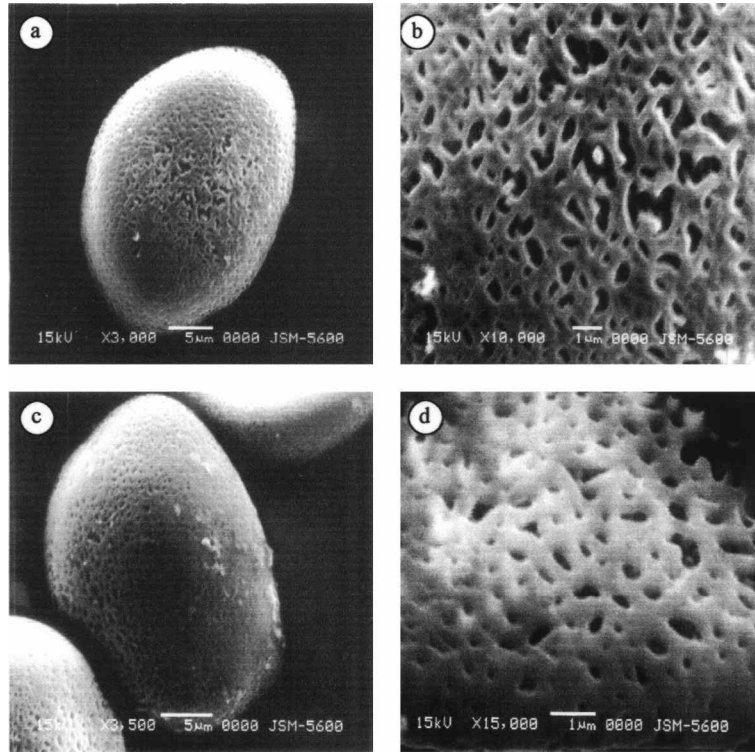


Figure 4. Equatorial view and detail exine surface in apolar functionally female cultivars Beyaz Çavuş (a-b) and Hönüsü (c-d).

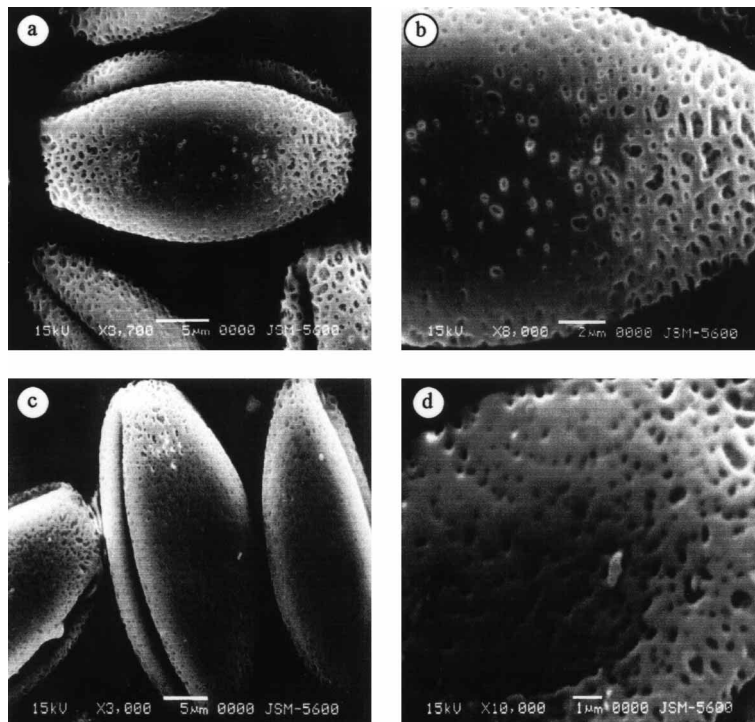


Figure 5. Equatorial view and detail exine surface in Tahannebi (a-b) and Siyah Gemre (c-d).

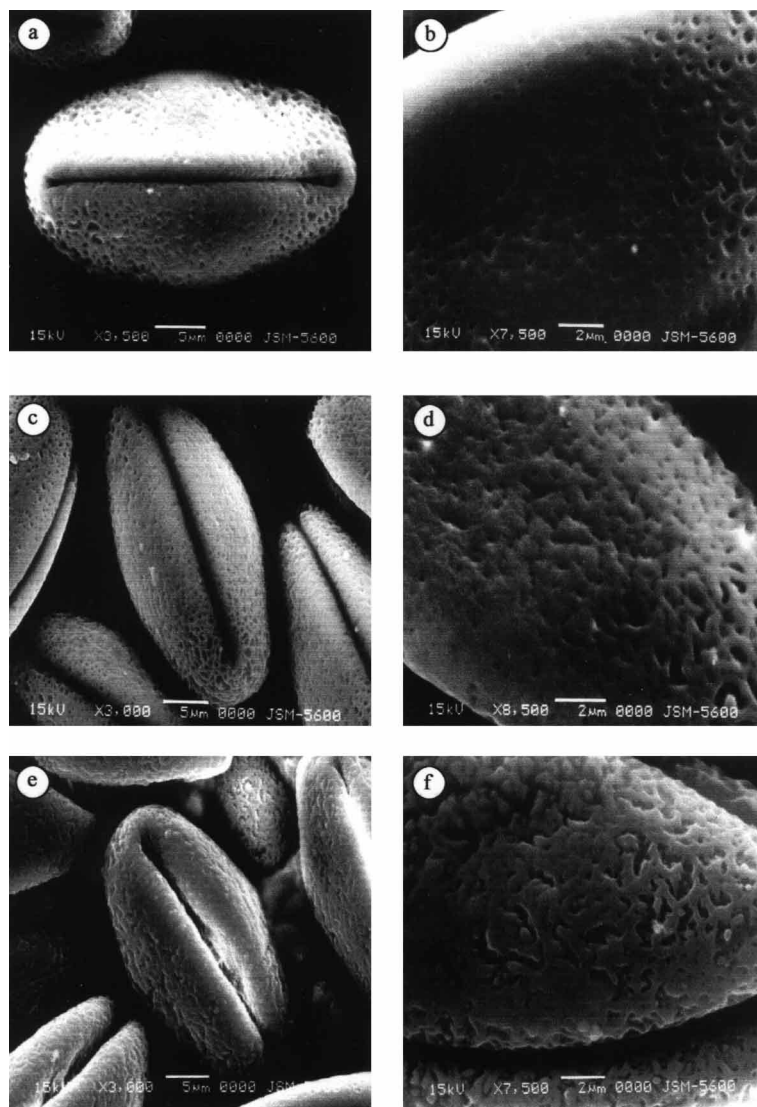


Figure 6. Equatorial view and detail exine surface ornamentation in hybrid cultivars. Ata sarısı (a-b), Uslu (c-d) and Yalova Incisi (e-f).

stated that from the *Vitis* cultivars in his study, those showing a tricolporate characteristic had a prolate or subprolate pollen shape and those showing an inaperturate characteristic had a prolate-spheroidal shape. Inceoğlu et al. (2000) determined that the *Vitis sylvestris* type had a prolate-spheroidal and subprolate pollen shape.

In the SEM studies, 4 types of ornamentation were observed in the mesocolpium region. It was determined that there was a reticulate ornamentation in Hönüsü, Beyaz Çavuş and Karagevrek, which show an inaperturate

characteristic, a perforate-rugulate ornamentation in Siyah Gemre and Uslu, a retipilate ornamentation in Yalova incisi and a foveolate ornamentation in Ata sarısı and Tahannebi. On the other hand, in the native cultivars examined in this study, it was determined that there was only a reticulate ornamentation in the apocolpium regions (Figures 4-6). Cabello Sáenz Santa Maria et al. (1994), in the *Vinifera* cultivars they examined, observed perforate-rugulate, rugulate and perforated ornamentation in the mesocolpium region. In the wild grapevine pollens obtained from the flora in Turkey, foveolate-rugulate

ornamentation was determined in the mesocolpium region and reticulate ornamentation was determined in the apocolpium region (Inceoğlu et al., 2000).

It was expected that the pollen grains in the functionally female grapevines would be tricolporate. The finding in this study of the functionally female Tahannebi pollen grains with a tricolporate structure, appeared as a finding which should be examined in future research. Within this scope, the Tahannebi cultivar collection at the

research station should be examined in detail in terms of its ampelographic characteristics and the flowers' biological characteristics.

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