

Pollen Morphology of Five Iranian Olive (*Olea europaea* L.) Cultivars

T. Javady¹ and K. Arzani^{1*}

ABSTRACT

Pollen grains of five olive cultivars (*Olea europaea* L.) were examined, using Scanning Electron Microscopy (SEM) for identification purposes. Four measurements, polar axis (P), equatorial diameter (E), P/E ratio and exine patterns were made. Forty pollen grains of each cultivar were viewed before finally selecting a representative pollen grain. Polar diameter ranged between 22.76 μm for the 'Mary' and 28.58 μm for the 'Shengeh' 'Zard' and 'Roghani' cultivars exhibited incomplete closure of the meshes. 'Zard' and 'Shengeh' cultivars had thick muri but 'Roghani', 'Mary' and 'Fishomi' possessed thinner muri. Scanning electron analysis of pollen grain revealed that specific differences including variation in size and form of the meshes are exist among cultivars. The differences in the exine pattern may help for the identification of some cultivars.

Keywords: Exine pattern, Olive (*Olea europaea* L.), Pollen analysis, Pollen grain, Scanning Electron Microscopy (SEM).

INTRODUCTION

Taxonomists and paleobotanists have recognized the importance of pollen development and morphology in clarifying the classification of plants (Martens and Fretz, 1980). Scanning electron microscopy studies on cultivated fruit trees have been carried out for taxonomic purposes using pollen (Lanza *et al.*, 1996). The studies were undertaken to determine interspecific and intraspecific relationships between fruit tree species. A number of specific pollen characteristics have been cited as useful for differentiation between closely related plant groups. Several workers suggested that pollen morphology, including size, shape and exine striation patterns may be useful for species identification (Martens and Fretz, 1980, Maas, 1977).

Pacini and Vosa (1979) studied exine pattern in nine olive cultivars using SEM. They

observed that differences in exine pattern among various cultivars mirror differences in size and shape of leaves and fruit, as well as in the general appearance of the tree. Westwood and Challice (1978) characterized pyrus species by observing pollen grain size and shape in addition to exine features such as ridge prominence, pore, as well as pit presence. Fogle (1977a, b) compared pollen of several fruit tree species, including peach, nectarine, plum, apple and sweet cherry through exine details obtained by scanning electron microscopy.

Differences in exine patterns between some cultivars have been noted in some species (Fogle, 1977, Maas, 1977) but not all cultivars exhibit very differentiated patterns. Recently, the isozyme techniques and random amplified polymorphic DNA (RAPD) markers have been used to distinguish fruit cultivars (Bogani, *et al.*, 1994, Ouazzani, *et al.*, 1994, Patumi, *et al.*, 1994; Wiesman *et*

¹ Department of Horticulture, Faculty of Agriculture, Tarbiat Modarres University, P.O. Box 14155-4838, Tehran, Islamic Republic of Iran.

* Corresponding author: Tel.: +98-21-6026522-24; Fax: +98-21-6026524; E-mail: arzani- k@ modares. ac. Ir.

**Table 1.** Characteristics of five olive cultivar pollen grains.

Cultivars	Pollen size (μm)		Distance between furrow edges ^a	P/E	Shape
	Polar axis (P) ^a	Equatorial diam (E) ^a			
Shengeh	25.58 \pm 0.87a ^b	19.14 \pm 0.93a	13.81 \pm 1.01a	1.339b	prolate
Zard	25.16 \pm 1.34a	17.48 \pm 1.44ab	11.707 \pm 1.05b	1.447ab	prolate
Roghani	23.77 \pm 0.82ab	16.69 \pm 1.02b	11.55 \pm 0.84b	1.429ab	prolate
Fishomi	23.46 \pm 1.18ab	15.95 \pm 0.91b	10.994 \pm 0.91b	1.473a	prolate
Mary	22.76 \pm 3.01b	16.85 \pm 2.51b	10.965 \pm 1.88b	1.357b	prolate

^aEach value represents the mean of 10 individual measurements \pm SD

^bMean separation in columns by Duncan's Multiple Range Test at (P=0.01)

al., 1998). For taxonomic purposes the best results are achieved by combining evidence from as many different fields or levels of organization as possible, such as morphological evidence, isozyme analysis and RAPD.

Olive is one of the fruit trees which will become important in the Iranian fruit industry in a near future. As a preliminary study, pollen exine structure was examined in five Iranian native olive cultivars using SEM technique.

MATERIALS AND METHODS

Pollen was collected in 1998 from olive trees (*Olea europaea* L.), cvs. Zard, Mary, Roghani, Fishomi and Shengeh grown in the orchard of Roodbar Olive Research Station located in Roodbar, Gailan province, Iran. Three branches selected from various parts of each tree (three to each cultivar) were isolated, before anthesis, with paper bags to avoid contamination from other pollen sources. The anthers were kept dry to allow pollen release. Pollen was collected in small vials and stored in desiccator at 3-5 °C until used.

For SEM evaluation, pollen samples were shaken for 30 minutes in a mixture of 1:1 chloroform and carbon disulphide in order to remove the triphyne as described by Pacini and Juniper method (1979).

Pollen grains were mounted on aluminium stubs with double-faced transparent tape and were coated with a gold layer of 200°A thick in a sputter coater. Samples on SEM stubs were stored in a desiccator prior to and fol-

lowing coating. Pollen grains observed at 20 KV with a Stereoscan 360 SEM were photographed at 5000 \times for whole grain and 15000 \times for exine pattern. Forty pollen grains of each cultivar were viewed before selecting as a representative pollen grain. Ten samples were measured in each cultivar. The polar axis, equatorial diameter and distance between two furrows were measured. The data were analysed and examined by analysis of variance and the means compared, using Duncan's Multiple Range Test.

RESULTS

There are 4 morphological features important to the description of olive pollen, 1) shape, 2) sculpturing of the exine, 3) size, and finally 4) P/E ratio. The differences between means, comparison of mesured char-

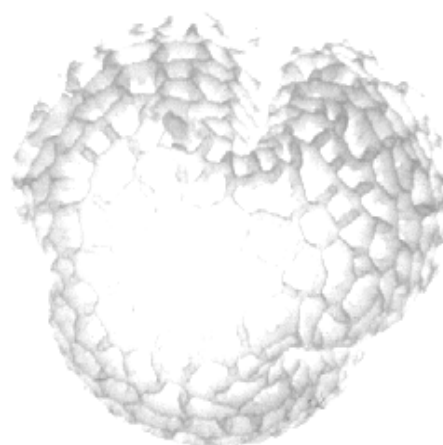


Figure 1. Polar view of olive pollen grain cv. Zard

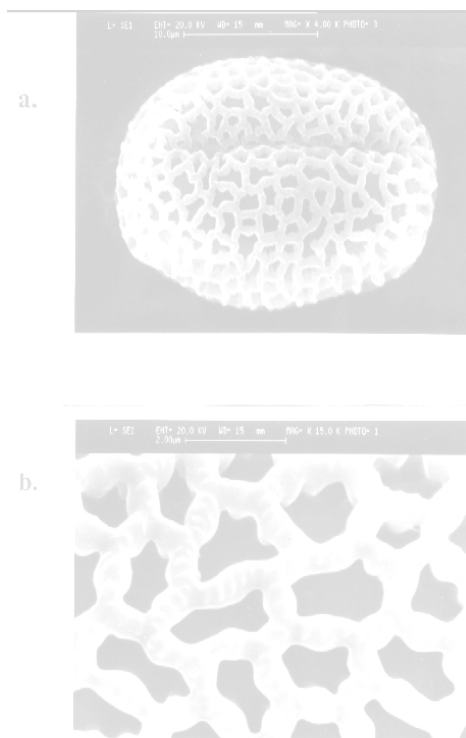


Figure 2. Pollen of olive, cv. Zard. Magnification: (a) $\times 4000$; (b) $\times 15000$. Scale represents 10 μm in photomicrograph (a) and 2 μm in (b).

acters, are shown in Table 1. The pollens of investigated cultivar showed diversity in shape, size, P/E ratio and exine characteristics (Table 1). Pollen grains in all cultivars were trizonocolpate (Fig.1). The outstanding characteristic of these grains was the reticulate exine.

The mean values of polar diameter ranged between 22.76 μm for 'Mary' and 28.58 μm for 'Shengeh' while equatorial diameter ranging between 15.95 μm for 'Fishomi' and 19.14 μm for 'Shengeh'. According to Erdtman (1971) terminology, pollen grains were placed in 1 shape group based on the P/E ratio (Table 1). The P/E ratio ranged from 1.34 to 1.47.

Results indicated that differences in exine pattern in studied cultivars were included three features, these being incomplete meshes, thickness of muri and mesh density in unit area. The incomplete closure of the meshes are found in 'Zard' and 'Roghani' cultivars (Fig. 2 a,b; Fig. 3 a,b). The culti-

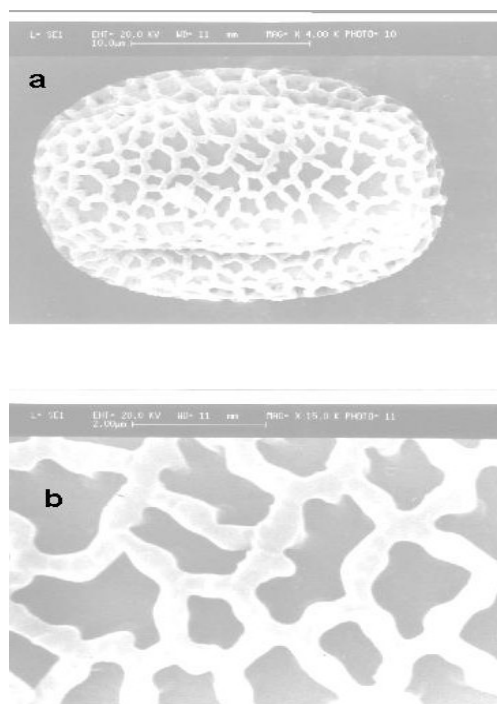


Figure 3. Pollen of olive, cv. 'Roghani'. Magnification: (a) $\times 4000$; (b) $\times 15000$. scale represents 10 μm in photomicrograph (a) and 2 μm in (b).

vars with thicker muri are 'Zard' and 'Shengeh' (Fig. 2a,b; Fig. 4 a,b). Cultivars with thinner muri are 'Roghani', 'Mary' and 'Fishomi' (Fig. 3 a,b; Fig. 5 a,b; Fig. 6 a,b).

The other important character was mesh density in which pollen of all the studied cultivars were placed in the following two groups:

1) Low density of mesh in unit area: Cvs. 'Mary', and 'Shengeh' belonged to this group (Fig. 5a,b; Fig. 4a,b).

2) High density of mesh in unit area: Cvs. 'Zard', 'Roghani', and 'Fishomi' belonged to this group (Fig. 2a,b; Fig. 3a,b; Fig. 6a,b).

DISCUSSION

This study supports the conclusion in Bohra and Sharma (1979) studies who reported that differences in exine patterns of olive cultivars including differences in dimension and shape of mesh, thickness of muri can be useful for the determination of

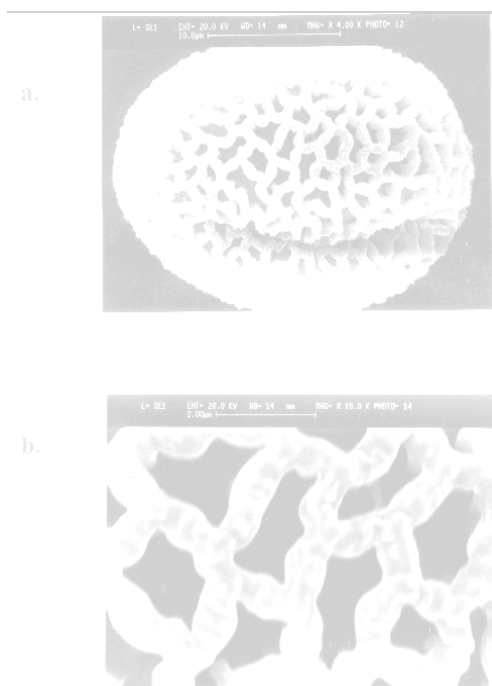


Figure 4. Pollen of olive, cv. 'Shengeh'. Magnification: (a)×4000; (b)×15000. Scale represents 10 μm in photomicrograph (a) and 2μm in (b).

olive cultivars.

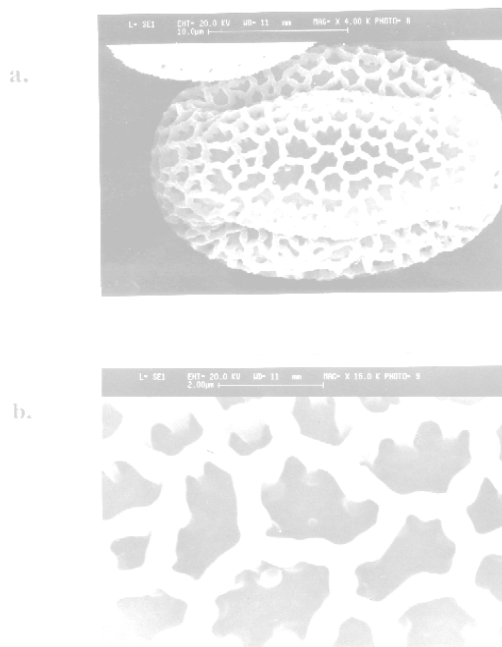


Figure 5. Pollen of olive, cv. 'Mary'. Magnification: (a)×4000; (b)×15000. Scale represents 10 μm in photomicrograph (a) and 2μm in (b).

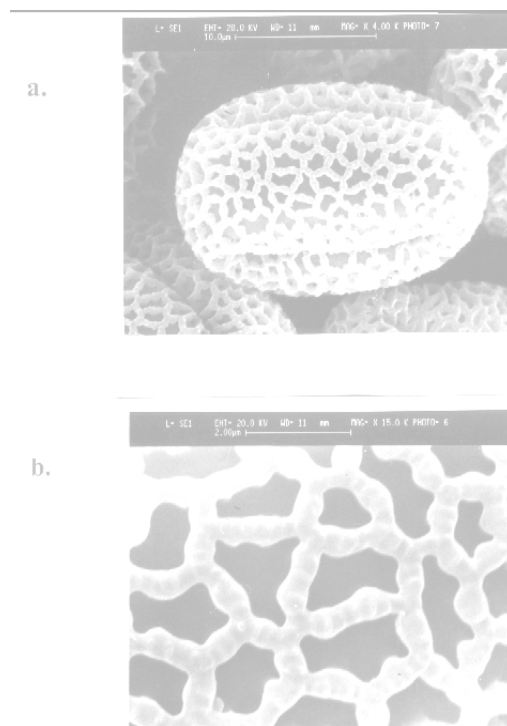


Figure 6. Pollen of olive, cv. Fishomi. Magnification: (a)×4000; (b)×15000. Scale represents 10 μm in photomicrograph (a) and 2μm in (b).

Large meshes were present in 'Shengeh' and 'Mary' while the muri were thick in 'Shengeh'cultivar, this character being constant in the former cultivars. Bohra and Sharma (1979) reported thicker muri in 'S. Francesco'and 'S. Agostino' while thinner muri in 'Grappolo' and 'Cornila' olive cultivars. P/E ratio based on means of pollar axis and equatorial diameter ranged from 1.34 to 1.47. The range for P/E ratio for pollen in 4 olive cultivars reported by Lanza et al. (1995) was from 1.32 for the 'Picoline' to 1.37 for the 'Leccino'.

A useful trait, from the ultrastructural point of view was mesh density in unit area. This trait permits the separation of 'Mary' and 'Shengeh' from 'Zard', 'Roghani and 'Fishomi' cultivars. Differences in exine pattern among some cultivars have been noted in olive, grapes, and in apple clones (Bohra and Sharma, 1979; Ahmedullah, 1983; Marcucci et al., 1984).

Four measurements made on pollen grains (polar axis, equatorial diameter, P/E ratio

and exin patterns) did not individually reveal great differences among cultivars. However, when all features are considered together the pollen of each cultivar exhibits a unique pattern. Thus, these pollen features along with morphological characteristics of tree can be employed for cultivar identification.

ACKNOWLEDGEMENT

The authors wish to thank Dr. Alireza Talei, University of Tehran, College of Agriculture for his helpful comments.

REFERENCES

- Ahmedullah, M. 1983. Pollen Morphology of Selected Vitis Cultivars. *J. Amer. Soc. Hort. Sci.*, **108(1)**: 155-160.
- Bogani, P., Cavalieri, D., Petruccelli, R., Polsinelli, L., and Roselli, G. 1994. Identification of Olive Tree Cultivars by Using Random Amplified Polymorphic DNA. *Acta Hort.*, **356**: 98-101.
- Erdtman, G. 1971. *Pollen Morphology and Plant Taxonomy*, Vol. 1: Angiosperms. Hofner, NewYork, pp.553.
- Fogle, H.W. 1977a. Identification of Clones Within four Tree Fruit Species by Pollen Ultrastructure. *J. Amer. Soc. Hort. Sci.*, **102**: 548-551.
- Fogle, H.W. 1977b. Identification of Tree Fruit Species by Pollen Ultrastructure. *J. Amer. Soc. Hort. Sci.*, **102**: 548-551.
- Lanza, B., Marsilio, V., and Martinelli, N. 1996. Olive Pollen Ultrastructure: Characterization of Exine Pattern Through Image Analysis- Scanning Electron Microscopy (IA- SEM). *Scien. Hort.*, **65**: 283-294.
- Maas, J.L. 1977. Pollen Ultrastructure of Strawberry and Other Small Fruit Crops. *J. Amer. Soc. Hort. Sci.*, **102**: 560-571.
- Marcucci, M.C., Sansavini, S., Ciampolini, F., and Cresti, M. 1984. Distinguishing Apple Clones and Cultivars by Surface Morphology and Pollen Physiology. *J. Amer. Soc. Hort. Sci.*, **109(1)**: 10-19.
- Martens, J., and Fretz, T.A. 1980. Identification of Eight Crabapples by Pollen Surface Sculpture. *J. Amer. Soc. Hort. Sci.*, **105(2)**: 257-263.
- Ouazzani, N., Lumaret, R., and Villemur, P. 1994. An evaluation to Approach the Genetic Variability of Olive Tree Using Enzymatic Markers. *Acta Hort.*, **356**: 91-94.
- Pacini, E., and Vosa, C.G. 1979. Scanning Electron Microscopy Analysis of Exine Patterns in Cultivars of Olive (*Olea europaea* L.). *Ann. Bot.*, **44**: 745-748.
- Patumi, M., Nucci, R., Vaccaro, C., and Fontanazza, G. 1994. Preliminary Studies on Isoenzymatic and Enzymatic Activities Isolated from Olive Plants. *Acta Hort.*, **356**: 95-97.
- Westwood, M.N., and Challice, J.S. 1978. Morphology and Surface Topography of Pollen and Anthers of Pyrus Species. *J. Amer. Soc. Hort. Sci.*, **103**: 28-37.
- Wiesman, Z., Avidan, N., Lavee, S., and Quebedeaux, B. 1998. Molecular Characterization of Common Olive Varieties in Israel and the West Bank Using Random Amplified Polymorphic DNA (RPAD) Markers. *J. Amer. Soc. Hort. Sci.*, **123(5)**: 837-841.

مورفولوژی دانه گرده پنج رقم زیتون (*Olea europaea* L.) ایران

چکیده

به منظور شناسایی مورفولوژی دانه‌های گرده، نمونه‌هایی از دانه گرده پنج رقم زیتون (*Olea europaea* L.)، با استفاده از میکروسکوپ الکترونی (SEM) بررسی شدند. اندازه‌گیری بر روی محور قطبی (P)،



قطر استوایی (E)، نسبت P/E و الگوی آگزین دانه‌های گرده انجام گرفت. قبل از انتخاب دانه گرده نمونه برای اندازه‌گیری‌های نهایی، حداقل ۴۰ دانه گرده از هر رقم بازمینی شدند. طول محور قطبی معادل $22/76 \mu\text{m}$ در رقم ماری $28/58 \mu\text{m}$ در رقم شنگه بود. بر روی دانه گرده ارقام زرد و روغنی شبکه‌های ناکامل وجود داشت. بر روی دانه گرده ارقام زرد و شنگه خطوط برجسته ضخیم مشاهده گردید. اما در ارقام روغنی، ماری و فیشمی خطوط برجسته روی گرده نازکتر بود. آنالیز میکروسکوپی دانه گرده تفاوت‌های خاصی را شامل گوناگونی در اندازه و شکل شبکه‌های روی دانه گرده نشان داد. نتایج حاصله نشان داد که از الگوی آگزینی دانه گرده ارقام مورد مطالعه می‌توان در مطالعات شناسایی ارقام کمک گرفت.