A. M. HAYRAPETYAN

POLLEN OF TREES AND SHRUBS OF ARMENIA (ANGIOSPERMAE. VI. *Platanaceae*, *Polygonaceae*, *Punicaceae*, *Ranunculaceae*, *Rhamnaceae*)

This paper is a sixth part of a series was devoted to the palynological study of woody plants of Armenia. With the help of light (LM) and scanning electron (SEM) microscopes investigations of pollen morphology of 13 species of Armenian trees and shrubs from the families *Platanaceae* Dumort., *Polygonaceae* Juss., *Punicaceae* Horan., *Ranunculaceae* Juss., *Rhamnaceae* Juss. have been carried out.

Pollen morphology, trees, shrubs, LM, SEM

Հայրապետյան Ա.Մ. Հայաստանի ծառերի և թփերի ներկայացուցիչների ծաղկափոշու ուսումնասիրությունը (Angiospermae. VI. *Platanaceae*, *Polygonaceae*, *Punicaceae*, *Ranunculaceae*, *Rhamnaceae*): Ներկայացված հոդվածը վեցերորդն է հոդվածների շարքում, որոնք նվիրված են Հայաստանի դենդրոֆլորայի ներկայացուցիչների ծաղկափոշու ուսումնասիրությանը: Լուսային (ԼՄ) և սկաներային էլեկտրոնային (ՍԷՄ) մանրադիտակների օգնությամբ ուսումնասիրվել է *Platanaceae* Dumort., *Polygonaceae* Juss., *Punicaceae* Horan., *Ranunculaceae* Juss., *Rhamnaceae* Juss. ընտանիքներին պատկանող ծառերի և թփերի 13 տեսակների ծաղկափոշու մորֆոլոգիան:

Ծաղկափոշու մորֆոլոգիա, ծառեր, թփեր, ԼՄ, ՍԷՄ

Айрапетян А.М. Морфология пыльцы деревьев и кустарников Армении (Angiospermae. VI. *Platanaceae*, *Polygonaceae*, *Punicaceae*, *Ranunculaceae*, *Rhamnaceae*). Данная статья является шестой из серии статей, посвященных исследованию морфологии пыльцы представителей дендрофлоры Армении. С помощью светового (СМ) и сканирующего электронного (СЭМ) микроскопов изучена пыльца 13 видов деревьев и кустарников из семейств *Platanaceae* Dumort., *Polygonaceae* Juss., *Punicaceae* Horan., *Ranunculaceae* Juss., *Rhamnaceae* Juss.

Морфология пыльцы, деревья, кустарники, СМ, СЭМ

The results of investigation of pollen morphology of 13 representatives of Armenian dendroflora relating to the families *Platanaceae* Dumort., *Polygonaceae* Juss., *Punicaceae* Horan., *Ranunculaceae* Juss., *Rhamnaceae* Juss. were presented.

MATERIAL AND METHODS

The material studied was obtained from the herbaria of the Institute of Botany after A. Takhtajyan NAS Republic of Armenia, Yerevan (ERE) and Botanical Institute, St.-Petersburg, Russia (LE).

The descriptions of the pollen grains with the help of the light microscope are based on the grains stained with basic fuchsine (Smoljaninova, Golubkova, 1950), and also on the simplified acetolysis method (Avetisyan, 1950). Pollen grains for the scanning electron microscopes (Jeol, JSM-35; Jeol, JSM-6390) were vacuum sputter-coated with gold and investigated in the laboratory of electronic microscopy of Botanical Institute, St.-Petersburg, Russia.

Ten pollen grains were examined and measured for each investigated specimen.

Specimens examined:

PLATANACEAE Dumort.: *Platanus orientalis* L.: Армения, Ереван, уличные посадки (Armenia, Yerevan, street planting) (ERE, 56159);

POLYGONACEAE Juss.: ***Atraphaxis caucasica*** (Hoffm.) N. Pav.: ГрузССР, окрестности г. Тбилиси, хребет Телети. Leg. E. Kenig (Georgian SSR, the vicinity of the Tbilisi, Teleti mountain ridge. Leg. E. Kenig) (ERE, 56696); ***A. spinosa*** L.: Армения, Арташатский р-н, сс. Гарни-Зовашен. Leg. В. Манакян и др. (Armenia, Artashat district, between Garni and Zovashen villages. Leg. V. Manakyan et al.) (ERE, 108947); Арм. ССР, Ехегнадзорский р-н, между селами Гнишик и Аяр (Агаракадзор), ю.-в. скалистый склон с фриганоидной растительностью. Leg. Я. Мулкиджанян (Armenian SSR, Yeghegnadzor district, between villages Gnishik and Ajar (Agarakadzor), S.-E. rocky slope with friganoid vegetation. Leg. Ya. Mulkidjanian) (ERE, 105752); ***Calligonum polygonoides*** L.: Армения, Веди, с. Горован. Leg. Я. Мулкиджанян, В. Агабабян, Э. Габриэлян (Armenia, Vedi, Gorovan village. Leg. Ya. Mulkidjanian, V. Agababian, E. Gabrielyan) (ERE, 77080); Армения, Араратский р-н., окрестности с. Гораван. Leg. Э. Габриэлян, К. Таманян (Armenia Ararat district, the vicinity of the Gorovan village. Leg. E. Gabrielyan, K. Tamanyan) (ERE, 109868);

PUNICACEAE Horan.: ***Punica granatum*** L.: Армения, Горисский р-н, Сатани Камурдж. Leg. Я. Мулкиджанян (Armenia, Goris district, Satani Kamurj. Leg. Ya. Mulkidjanian) (ERE, 87155); АрмССР, Зангезур, окр. с. Анд, у дороги. Leg. В. Манакян, Я. Мулкиджанян (Armenian SSR, Zangezour, vicinity of And village, beside the road. Leg. V. Manakyan, Ya. Mulkidjanian) (ERE, 85832);

RANUNCULACEAE Juss.: ***Clematis orientalis*** L.: Plantae Armeniacae, Даралагизский уезд, долина р. Вост. Арпачай, близ с. Арпы. Leg. I. Novopokrovsky (Plantae Armeniacae, Darelegis county, East Arpachay river valley, near Arpa village. Leg. I. Novopokrovsky (LE); АрмССР, Ехегнадзорский р-н, между сс. Аяр (Агаракадзор) и Енгиджа (Гандзак), у источника. Leg. А. Ахвердов, Н. Мирзоева (Armenian SSR, between Ajar (Agarakadzor) and Egindgha (Gandzak) villages, near the source. Leg. A. Akhverdov, N. Mirzoeva) (ERE, 138242); *C. vitalba* L.: Армения, Ереван. Leg. Ярошенко (Armenia, Yerevan. Leg. Jaroshenko) (ERE, 135988);

RHAMNACEAE Juss.: ***Frangula alnus*** Mill.: АрмССР, Даралегиз, ущ. Арпачай. Leg. Я. Мулкиджанян (Armenian SSR, Darelegis, Arpachaj gorge. Leg. Ya. Mulkidjanian) (ERE, 20623); АрмССР, Алаверд. р-н, Ахпат х Алаверды, у шоссе над родником. Leg. Я. Мулкиджанян (Armenian SSR, Alaverdi district, between Akhpat and Alaverdi, near the highway above the spring. Leg. Ya. Mulkidjanian) (ERE, 57011); ***Paliurus spina-christi*** Mill.: Dary-Dagh. Leg. A. Schelkovnikov et E. Kara-Murza (ERE, 20568); Дагест. АССР, с. Кумторкала, 20 км от г. Махачкала. У дороги по склону реки. Leg. Н. Н. Цвелев, С. К. Черепанов, Г. Н. Непли, А. Е. Бобров (Dagestan ASSR, village Kumtorkala, 20 km from Makhachkala. Near the road along the slope of the river. Leg. N. N. Tsvelev, S. K. Cherepanov, G. N. Nepli, A. E. Bobrov (LE); ***Rhamnus cathartica*** L.: АрмССР, Мегринский р-н, Мегри х Личк. Leg. Я. Мулкиджанян (Armenian SSR, Megri district, between Megri and Lichk. Leg. Ya. Mulkidjanian) (ERE, 87100); Армения, окр. Еревана, ущелье реки Раздан. Leg. Э. Габриэлян, А. Погосян (Armenia, near Yerevan, Hrazdan gorge. Leg. E. Gabrielyan, A. Poghosyan) (ERE, 79766); ***R. microcarpa*** Boiss.: ГрузССР, окр. Бакуриани, ю.-зап. макросклон г. Цхра-Цхаро. Leg. Э. Габриэлян (Georgian SSR, Bakuriani neighborhood, south-western slopes of mount Tskhra-Tskharo. Leg. E. Gabrielian) (ERE, 27261); ***R. pallassii*** Fisch. et C. A. Mey.: Армения, Даралагез, с. Арпа. Leg. Feodorov (Armenia, Darelegis, Arpa village. Leg. Feodorov) (ERE, 20635); Армения, Вединский р-н, 3 км сев. с. Дашлу, отроги хребта Ерах, гаммада, юго-восточный склон. Leg. Я. Мулкиджанян, В. Манакян (Armenia, Vedi district, 3 km northward of the village Dashlu, the spurs of the Erakh ridge, gammada, south-east slope. Leg. Ya. Mulkidjanian, V. Manakyan (ERE, 72360); ***Ziziphus jujuba*** Mill.: Pr. stationem Allaverdy. Leg. A. Шелковников (Leg. A. Shelkovnikov) (ERE, 27186); АрмССР, Мегринский р-н, с. Легваз, лесные склоны. Leg. Аревшатян (Armenian SSR, Megri district, village Legvaz, forest slopes. Leg. Arevshatyan) (ERE, 116968).

RESULTS

PLATANACEAE Dumort.

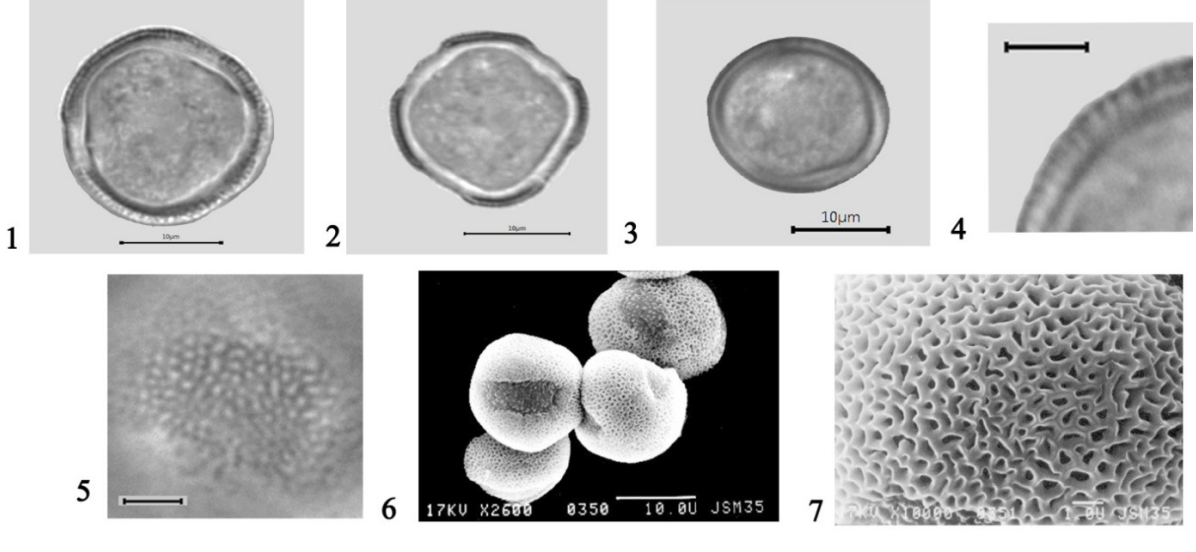
The total number of genera in Armenia – 2. The number of genera of trees and/or shrubs in Armenia – 2

Platanus L.

Samoilovich, 1950; Erdtman G. 1954; Avetisyan, Manukyan, 1958; Bassett et al., 1978; Trigo & Fernández, 1994; Jones et al., 1995; Beug, 2004; Tokarev, 2004

Trees. The number of species in Armenia – 2.

P. orientalis L. (phototable I). Pollen grains are 3(4)-zonocolpate, oblate-spheroidal or almost spheroidal, in polar view the outline is roundish or roundish-3(4)-angular; polar axis 13,7-17,0 μm, equatorial diameter 14,1-19,8 μm. Colpi are short, wide, with roundish ends; ornamentation of colpus membrane is granulate or verrucate; apocolpium diameter 7,5-8,8 μm, mesocolpium width 7,2-8,4 μm. Exine ornamentation is regularly finely reticulate (LM, SEM).



Phototable I. Pollen grains of *Platanus orientalis* L.
1, 2 – pollen grains from polar view (1 – 3-zonocolpate, 2 – 4-zonocolpate), 3 – pollen grain from equatorial view, 4 – exine, 5 – exine ornamentation (LM); 6 – pollen grains from polar and equatorial view; 5 – exine ornamentation (SEM) (scale bar: 1-3 – 10 μm, 4, 5 – 3 μm)

POLYGONACEAE Juss.

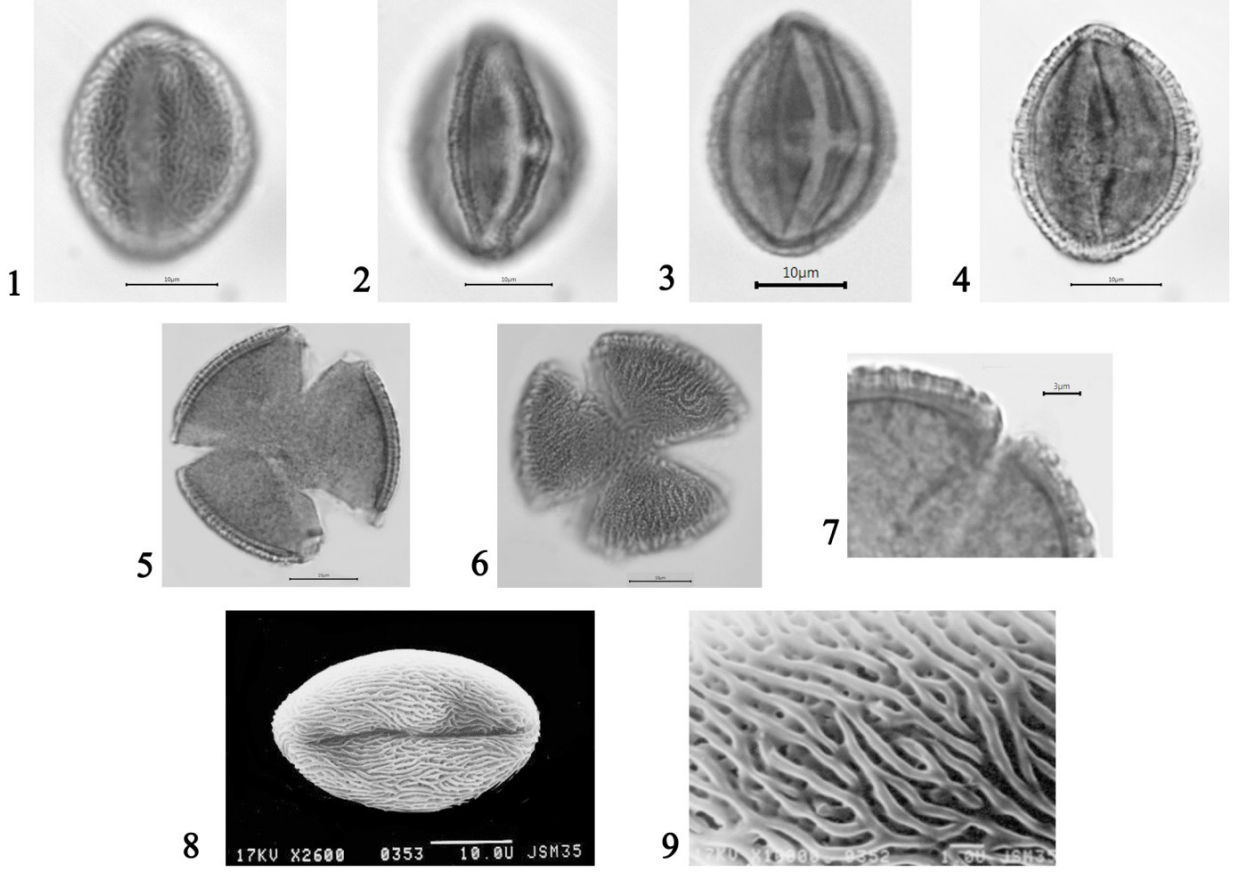
The total number of genera in Armenia – 7. The number of genera of trees and/or shrubs in Armenia – 2

Atraphaxis L.

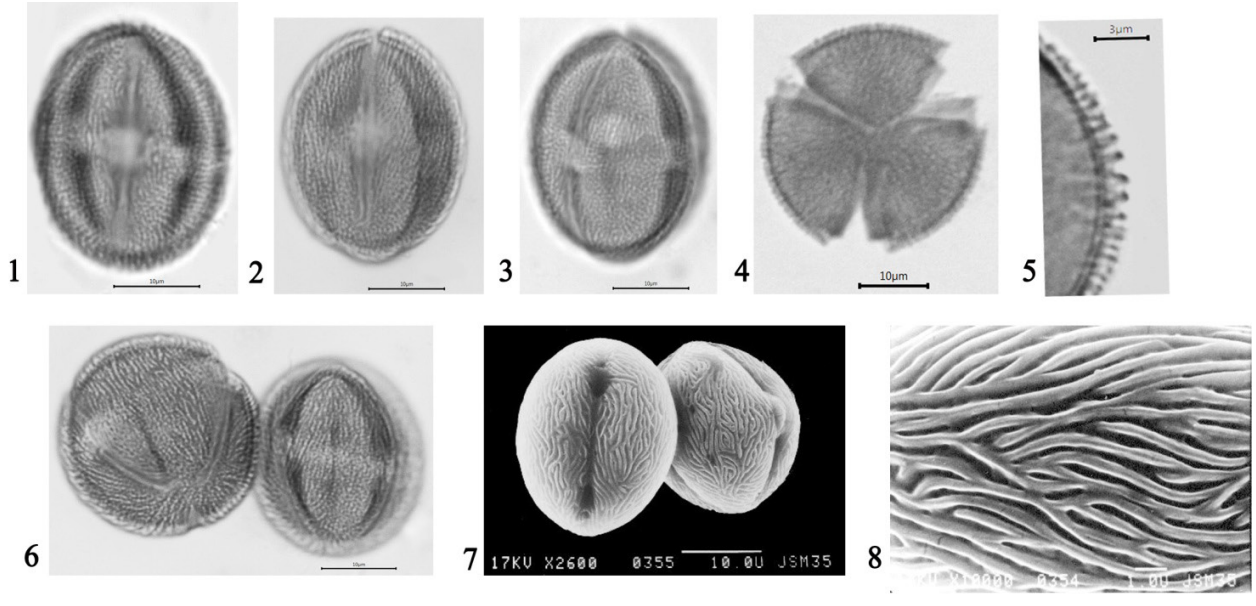
Avetisyan, Manukyan, 1956; Nowicke, Skvarla, 1977; Bao, Li, 1993; Suk-Pyo Hong, 1995; El-Naggar & El-Husseini, 2001; Yurtseva et al., 2014, 2017

(plate. 1; phototables II, III)

Shrubs. The number of species in Armenia – 4. Pollen grains are 3-zonocolp-oroidate (*A. caucasica* (Hoffm.) N. Pav.) or 3-zonocolp-orate, oblong in shape, in polar view the outline is roundish or roundish-3-lobed; polar axis 20,0-33,5 μm, equatorial diameter 18,0-32,0 μm. Colpi are long, not wide or narrow, with roundish ends; ornamentation of colpus membrane is psilate; apocolpium diameter 4,8-7,7 μm, mesocolpium width 15,5-24,0 μm; along colpi edges a thickening of the exine layer is observed. Ora are weakly expressed (*A. caucasica*), broadly elliptical or with parallel edges, ends diffuse (*A. spinosa*). Exine 1,4-1,5 μm, with thin tectum, columns thin, capitate. Exine ornamentation is sinuously striate, striae long (LM); exine ornamentation is sinuously striate (*A. spinosa*) or reticulate-striate (*A. caucasica*) (SEM).



Phototable II. Pollen grains of *Atrafaxis caucasica* (Hoffm.) N. Pav.
1-4 – pollen grains from equatorial view, 5, 6 – pollen grain from polar view, 7 – exine (LM);
8 – pollen grain from equatorial view (colpus); 9 – exine ornamentation (SEM)
(scale bar: 1-6 – 10 μm, 7 – 3 μm)



Phototable III. Pollen grains of *Atrafaxis spinosa* L.
1-3 – pollen grains from equatorial view, 4 – pollen grain from polar view, 5 – exine,
6 – pollen grains from semipolar and equatorial view (LM); 7 – pollen grains from polar view; 8 – exine ornamentation (SEM) (scale bar: 1-4, 6 – 10 µm, 5 – 3 µm)

Plate 1. Palynomorphological characteristics of some species of the genus *Atraphaxis* L

Species	Pollen grain size (P x E)[1] (µm)	Colpus		Exine ornamentation	
		apocolpium diameter (µm)	mesocolpium width (µm)	LM	SEM
A. caucasica (Hoffm.) N. Pav.	24,5-32,1 x 20,8-23,1	4,5-6,8	21,0-23,2	sinuously striate, striae long	reticulate-striate
A. spinosa L.	21,0-23,5 x 18,1-22,5	3,8-4,8	12,5-14,5	– // –	sinuously striate

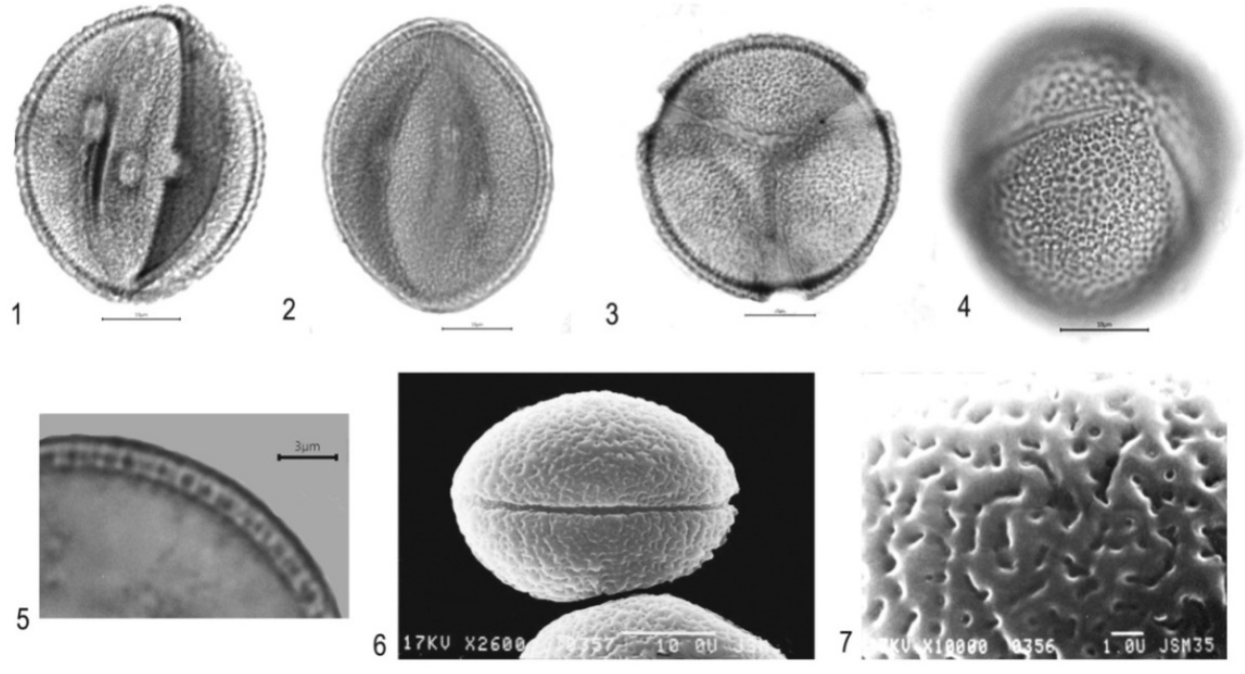
Calligonum L.

Avetisyan, Manukyan, 1956; Nowicke, Skvarla, 1977; Kuprianova, Alyoshina, 1978; Ryabkova, 1987; Khalkuziev, 1990; Ge, 1993; Sekina et al., 1995; Suk-Pyo Hong, 1995; Zhang, Xi, 1997; El-Naggar, El-Husseini, 2001; Kai-Qing Lu et al., 2018

Shrubs up to 1,5 m tall. The number of species in Armenia – 1.

C. polygonoides L. (phototable IV). Pollen grains are 3-zonocolp-porate, mostly wide-ellipsoidal, in polar view the outline is roundish or roundish-3-lobed; polar axis 27,8-32,1 µm, equatorial diameter 22,4-28,1 µm. Colpi are very long, sometimes ends anastomose at the pole (phototable IV, 3), narrow, with almost parallel edges, the ends are slightly pointed; apocolpium diameter 4,0–4,7 µm, mesocolpium width 19,2–21,0 µm. Pores are elliptical, slightly go beyond the colpi, bordered, pore membrane is granular (LM). Exine 1,3–1,5 µm, tectum is thick, columellae are densely spaced, thin, rounded at the ends. Exine ornamentation is punctuate-tuberculate (LM); exine ornamentation is a perforate and sinuously plicate (SEM).

[1] P – polar axis, E – equatorial diameter



Phototable IV. Pollen grains of *Calligonum polygonoides* L.
1, 2 – pollen grains from equatorial view, 3 – pollen grain from polar view, 4 – pollen grain from semipolar view, 5 – exine (LM); 6 – pollen grain from equatorial view; 7 – exine ornamentation (SEM)
(scale bar: 1-4 – 10 µm, 5 – 3 µm)

PUNICACEAE Horan.

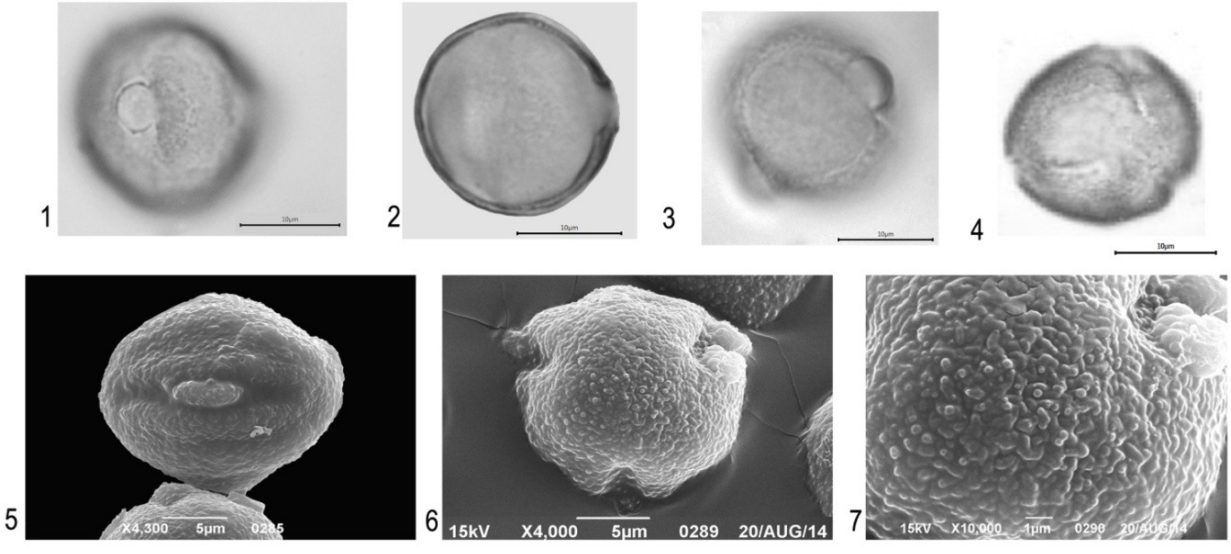
The total number of genera in Armenia – 1. The number of genera of trees and/or shrubs in Armenia – 1

Punica L.

Erdtman, 1952; Nair, 1961; Avetisyan, Mekhakyan, 1973; Zhao Xiangui, Xial Ling. 1996; Beug, 2004; Varasteh, Arzani. 2009; Yang et al., 2015

Shrubs. The number of species in Armenia – 1.

P. granatum L. (phototable V). Pollen grains are 3-zonocolp-porate, wide-ellipsoidal or almost spheroidal in shape, in polar view the outline is roundish-triangular; polar axis is 17,1–20,7 µm, equatorial diameter 15,5–18,8 µm. Colpi are long, narrow, pointed at the ends, colpus membrane is smooth; apocolpium diameter 5,5–8,2 µm, mesocolpium width 12,4–14,5 µm. Pores are elliptical, 5,3 x 3,2 µm in diameter, pore membrane is smooth. Exine 1,3-1,4 µm. Exine ornamentation is sinuously spotted (LM); exine ornamentation is plicate-tuberculate (SEM).



Phototable V. Pollen grains of *Punica granatum* L.
1-3 – pollen grains from equatorial view, 4 – pollen grain from semipolar view (LM);
5 – pollen grain from equatorial view, 6 – pollen grain from polar view, 7 – exine ornamentation (SEM)
(scale bar: 1-4 – 10 µm)

***RANUNCULACEAE* Juss.**

The total number of genera in Armenia – 16. The number of genera of trees and/or shrubs in Armenia – 1

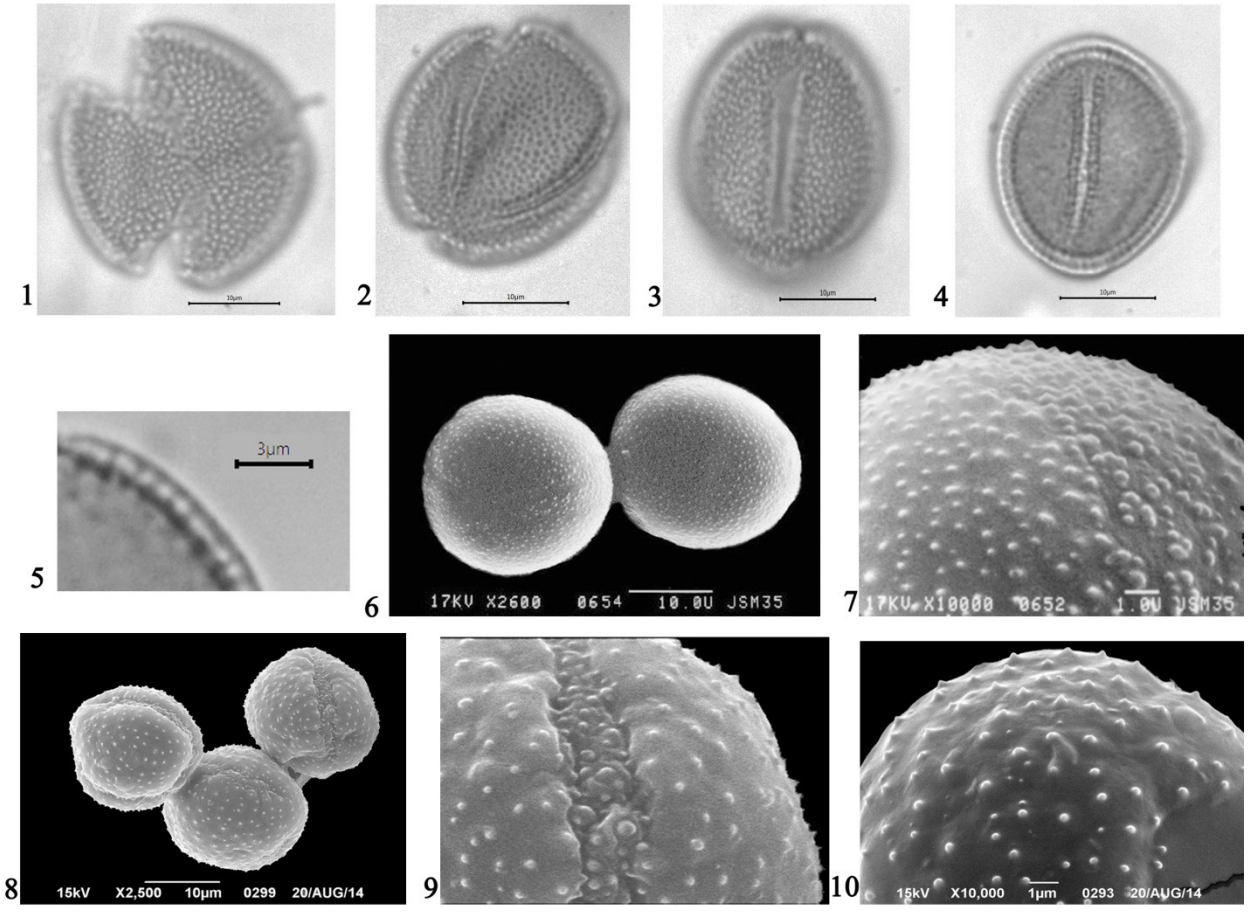
***Clematis* L.**

Ting Su, 1949; Erdtman, 1952; Avetisyan, Manukyan, 1954; Myachina et al., 1971; Savitsky, 1978; Mkrtchyan, 1985; Valdes et al., 1987; Kapoor et al., 1989; Clarke et al., 1991; Jones et al., 1995; Xie, Li, 2012; Habibi et al., 2014

(plate 2, phototable VI)

Climbing shrubs. Number of species in Armenia – 2.

Pollen grains are 3-zonocolpate, broadly ellipsoidal or almost spheroidal in shape, in polar view the outline is rounded-triangular or rounded-3-lobed; polar axis 15,0–25,7 µm, equatorial diameter 13,5–18,5 µm. Colpi are long, not wide, the ends are slightly rounded, ornamentation of the colpus membrane is irregularly granulate or verucate (SEM); along the colpi edges exine layer is thickened (*C. orientalis*) (phototable VI, 4). Exine ornamentation is inversely reticulate (LM); exine ornamentation is spinulate (SEM).



Phototable VI. Pollen grains of some species of the genus *Clematis* L.
1-7 – *C. orientalis* L. (1 – pollen grain from polar view, 2 – pollen grain from semipolar view, 3-4 – pollen grains from equatorial view, 5 – exine (LM), 6 – pollen grains from polar and equatorial view, 7 – exine ornamentation (SEM)); 8-10 – *C. vitalba* L. (8 – pollen grains from polar and equatorial view, 9-10 – ornamentation of exine and colpus membrane (9) (SEM))
(scale bar: 1-4 – 10 µm, 5 – 3 µm)

Plate 2. Palynomorphological characteristics of some species of the genus *Clematis* L.

Species	**Pollen grain size (P x E)** (µm)	**Colpus**		**Exine ornamentation**	
		apocolpium diameter (µm)	**mesocolpium width** (µm)	**LM**	**SEM**
C. orientalis L.	20,5-25,7 x 18,8-22,1	3,5-4,7	21,0-22,6	inversely reticulate	irregularly spinulate
C. vitalba L.	15,0-18,5 x 13.5-18,1	3,8-4,8	10,1-12,5	– // –	regularly spinulate

RHAMNACEAE Juss.

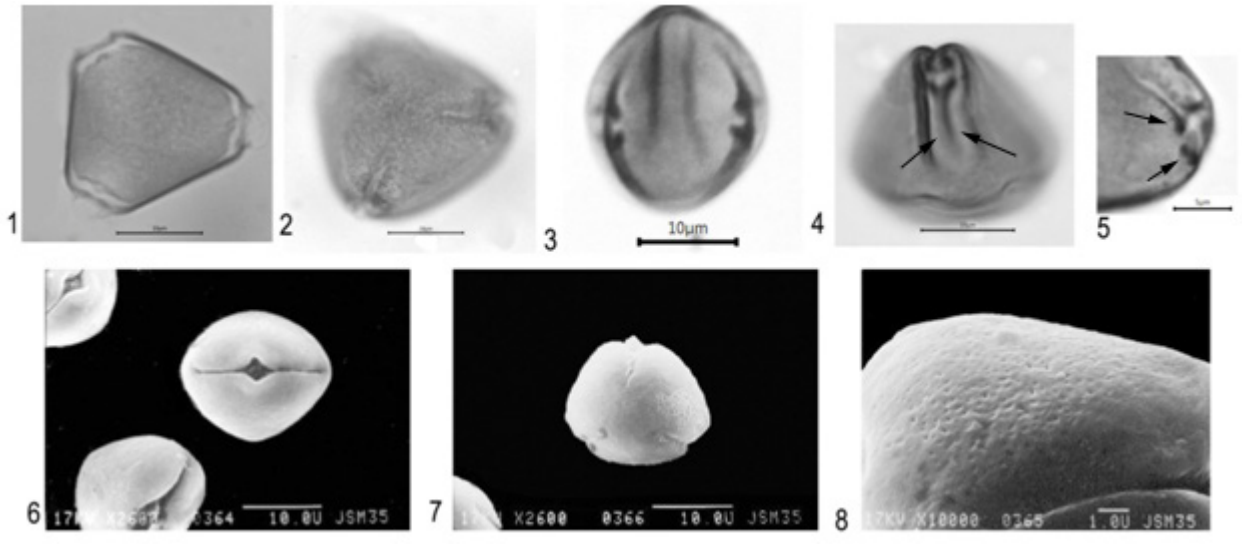
The total number of genera in Armenia – 4. The number of genera of trees and/or shrubs in Armenia – 4.

Frangula Mill.

Avetisyan, Mekhakyan, 1973; Kuprianova, Alyoshina, 1978; Valdes et al., 1987; Jones et al., 1995; Tokarev, 2004; Punt et al., 2003

Small trees or shrubs. The number of species in Armenia – 1.

F. alnus Mill. (phototable VII). Pollen grains are 3-zonocolp-orate with paracolpi[1], broadly ellipsoidal in shape, in polar view the outline is triangular; polar axis 18,5–20,8 µm, equatorial diameter 16,5–18,3 µm. Colpi are not long, narrow, the ends are pointed; apocolpium diameter 9,2-9,8 µm, mesocolpium width 20,5-21,5 µm. Paracolpi are long, crescent-shaped. Ora are elliptic, the ends are diffuse; along the ora edges exine thickening is noted (phototable VI, 5). Exine 0,8–1,0 µm, columellae layer is weak. Exine ornamentation is punctate (LM); exine ornamentation is perforate, perforations are densely spaced, the surface of the pollen grains is slightly wavy (SEM).



Phototable VII. Pollen grains of *Frangula alnus* Mill.
1-2 – pollen grains from polar view, 3 – pollen grain from equatorial view,
4 – paracolpi (marked by arrows), 5 – exine thickening around os (marked by arrows) (LM); 6 – pollen grain from equatorial view, 7 – pollen grain from polar view, 8 – exine ornamentation (SEM) (scale bar: 1-4 – 10 µm, 5 – 6 µm)

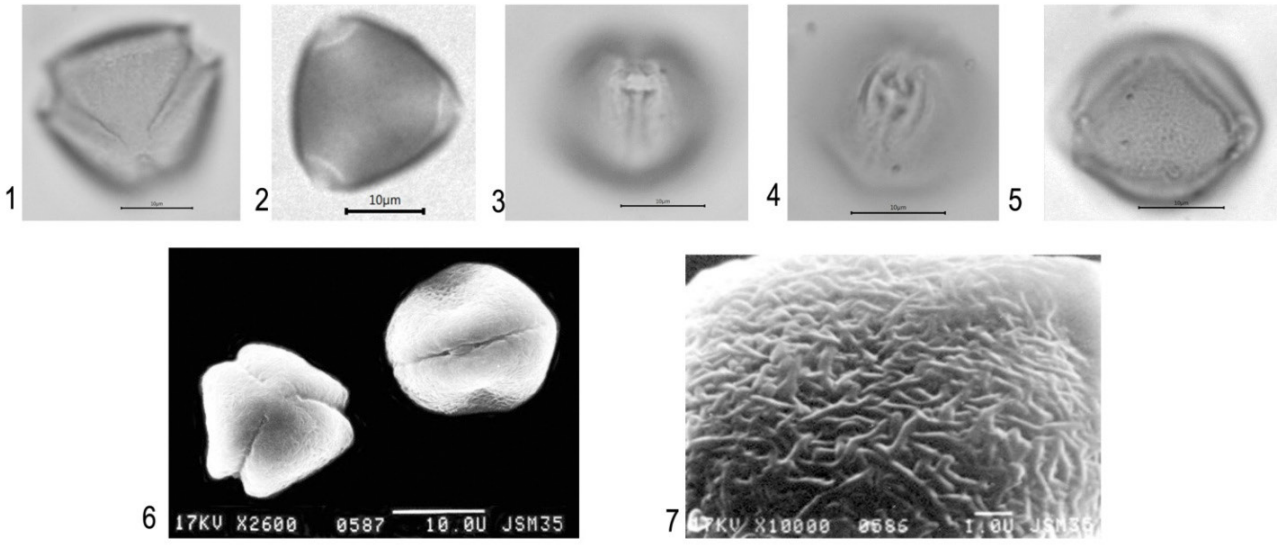
Paliurus Mill.

Avetisyan, Mekhakyan, 1973; Kuprianova, Alyoshina, 1978; Schirarend, 1996

Shrubs and small trees. The number of species in Armenia – 1.

P. spina-christi Mill. (phototable VIII). Pollen grains are 3-zonocolp-orate with paracolpi, from broadly ellipsoidal to oblate spheroidal, in polar view the outline is roundish-triangular; polar axis 14,1-18,2 µm, equatorial diameter 18,5-23,3 µm. Colpi long, narrow, sometimes almost slit-like, the ends are pointed; apocolpium diameter 3,8–4,2 µm, mesocolpium width 17,5–21,0 µm. Paracolpi not long, crescent-shaped (phototable VII, 4). Ora with almost parallel edges, the ends are diffuse; exine thickening at the crossing angles of colpi and ora is noted. Exine 0,6-0,8 µm, columellae layer is weak. Exine ornamentation is large spotted-cellular (LM); exine ornamentation is sinuously finely plicate (SEM).

1 Paracolpi – colp-shape parts of thinned endexine, located on both sides of the colpi (Yeramyan, 1971). In our opinion, paracolpi in their structure are homologs of ora.



Phototable VIII. Pollen grains of *Paliurus spina-christi* Mill.
1-2 – pollen grains from polar view, 3 – exine thickening around os, 4 – paracolpi, 5 – pollen grain from equatorial view (LM); 6 – pollen grains from polar and equatorial view, 7 – exine ornamentation (SEM) (scale bar: 1-5 – 10 µm)

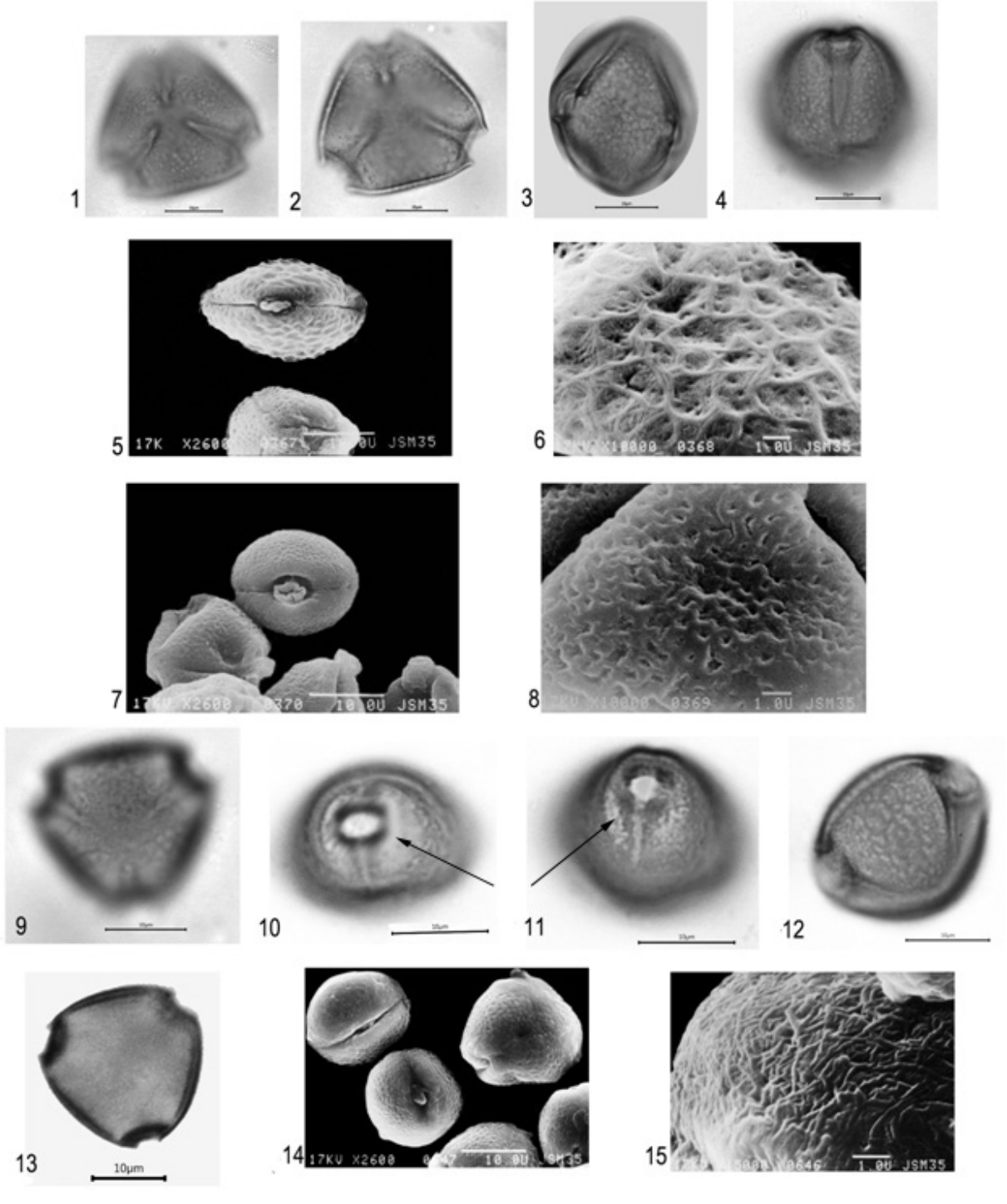
Rhamnus L.

Erdtman, 1954; Erdtman et al., 1961; Richard, 1970; Myachina et al., 1971; Avetisyan, Mekhakyan, 1973; Kuprianova, Alyoshina, 1978; Valdes et al., 1987; Jones et al., 1995; Premathilake & Nilsson, 2001; Punt et al., 2003; Tokarev, 2004; Perveen, Qaiser, 2005; Naimat et al., 2012

(plate 3, phototable IX)

Small trees or shrubs. Number of species in Armenia – 5.

Pollen grains are 3-zonocolp-orate with paracolpi, narrow or broadly ellipsoidal, in polar view the outline is roundish-triangular. Colpi are long, narrow, often slit-like, rounded to the ends. In species *R. cathartica* L. and *R. microcarpa* Boiss. paracolpi are weakly expressed, in species *R. pallassii* Fisch. et C. A. Mey. paracolpi are long, crescent-shaped, reaching almost to the ends of colpi (phototable VIII, 10-11). Ora are elliptic, the ends are diffuse; for all species the thickening of the exine layer at the intersections of colpi and ora is observed. Exine 0,6-0,9 µm, columellae layer is weak. Exine ornamentation is reticulate (LM); exine ornamentation is represented by various transitional versions from plicate to reticulate or their simultaneous combination (phototable VIII).



Phototable VIII. Pollen grains of some species of the genus *Rhamnus* L.
1-6 – *R. cathartica* L. (1-2 – pollen grains from polar view, 3 – pollen grain from equatorial view, 4 – colpus end and ornamentation (LM), 5 – pollen grain from equatorial view, 6 – exine ornamentation (SEM)); 7-8 – *R. microcarpa* Boiss. (7 – pollen grain from equatorial view, 8 – exine ornamentation (SEM)); 9-15 – *R. pallassii* Fisch. et C. A. Mey. (9 – pollen grain from polar view, 10-12 – pollen grains from equatorial view: 10 – os, 10, 11 – paracolpi (marked by arrows), 12 – exine ornamentation, 13 – pollen grain from polar view (LM); 14 – pollen grains from polar and equatorial view,15 – exine ornamentation (SEM)).
(scale bar: 1-4, 9-13 – 10 µm)

Plate 3. Palynomorphological characteristics of some species of the genus *Rhamnus* L.

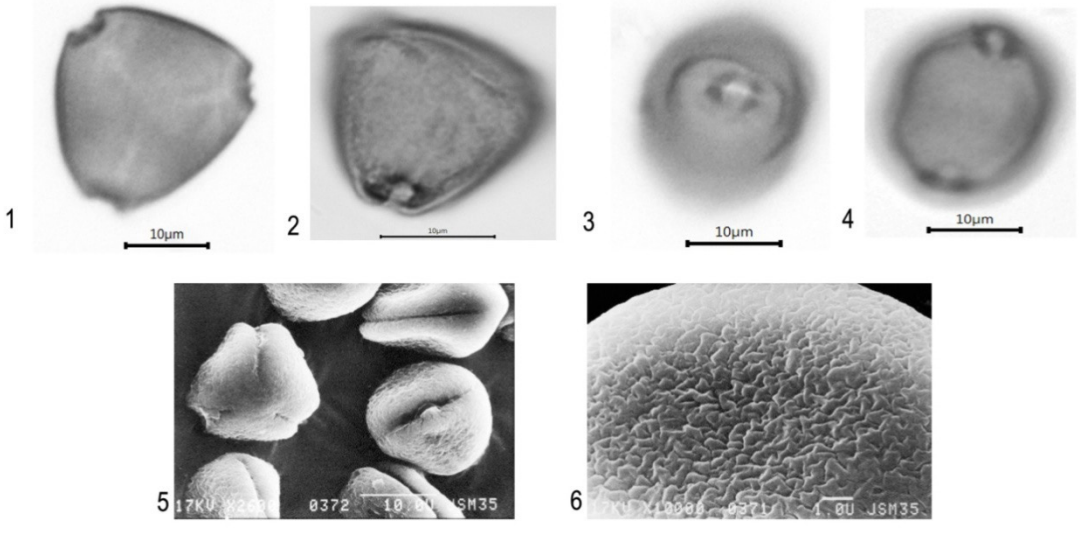
Species	Pollen grain size (P x E) (μm)	Colpus		Exine ornamentation	
		apocolpium diameter (μm)	mesocolpium width (μm)	LM	SEM
R. cathartica L.	21,0-23,5 x 15,2-21,6	4,5-5,0	13,8-14,6	reticulate	reticulate with perforations at the bottom of the lumina; muri 1-3 row, often branched
R. microcarpa Boiss.	14,2-15,8 x 12,5-14,7	4,8-5,3	12,0-13,3	microreticulate	foveate-microreticulate, muri are thick
R. pallassii Fisch. et C. A. Mey.	14,5-18,3 x 15,1-22,2	4,5-6,2	12.5-14,0	reticulate	reticulate, muri are thin, highly branched

Ziziphus Mill.

Avetisyan, Mekhakyan, 1973; Punt et al., 2003; Perveen, Qaiser, 2005; Aftab, Perveen, 2006; Naimat et al., 2012

Small trees or shrubs. The number of species in Armenia – 1.

Z. jujuba Mill. (phototable X). Pollen grains are 3(4)-zonocolp-orate with short, not always clearly defined paracolpi, oblate-spheroidal or almost spheroidal in shape, in polar view the outline is rounded-3(4)-angular; polar axis 13,5-15,5 μm, equatorial diameter 15,5-18,0 μm. Colpi are long, very narrow, almost slit-like, the ends are slightly pointed; apocolpium diameter 2,9-4,3 μm, mesocolpium width 14,1-17,1 μm. Ora are elliptic, the ends are diffuse; the thickening of the exine layer at the intersections of colpi and ora are noted. Exine 1,4-1,5 μm, columellae layer is weak. Exine ornamentation is spotted (LM), exine ornamentation is sinuously finely plicate (SEM).



Phototable X. Pollen grains of *Ziziphus jujuba* Mill.
1, 2 – pollen grains from polar view, 3, 4 – pollen grain from equatorial view (3 – aperture, 4 – mesocolpium; exine thickenings around os are visible) (LM), 5 – pollen grain from polar and equatorial view, 6 – exine ornamentation (SEM)
(scale bar: 1-4 – 10 μm)

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