HAYRAPETYAN A. M.

POLLEN OF TREES AND SHRUBS OF ARMENIA (ANGIOSPERMAE. IX. *Rosaceae*. Genera *Amelanchier, Amygdalus, Armeniaca*, *Cerasus, Cotoneaster*)

Pollen morphology of 15 species of Armenian trees and shrubs from the genera *Amelanchier* Medik., *Amygdalus* L., *Armeniaca* Mill., *Cerasus* Juss., *Cotoneaster* Medik. (family *Rosaceae* Juss.) was studied using light microscopy (LM) and scanning electron microscopy (SEM).

Pollen morphology, trees, shrubs, LM, SEM

Հայրապետյան Ա. Մ. Հայաստանի ծառերի և թփերի ներկայացուցիչների ծաղկափոշու ուսումնասիրությունը (Angiospermae. IX. *Rosaceae*. *Amelanchier, Amygdalus, Armeniaca*, *Cerasus, Cotoneaster* ցեղերը). Լուսային (ԼՄ) և սկաներային էլեկտրոնային (ՍԷՄ) մանրադիտակների օգնությամբ ուսումնասիրվել է Հայաստանի դենդրոֆլորայի *Amelanchier* Medik., *Amygdalus* L., *Armeniaca* Mill., *Cerasus* Juss., *Cotoneaster* Medik. (*Rosaceae* Juss. ընտ.) ցեղերին պատկանող 15 տեսակների ծաղկափոշու մորֆոլոգիան:

Ծաղկափոշու մորֆոլոգիա, ծառեր, թփեր, ԼՄ, ՍԷՄ

Айрапетян А. М. Морфология пыльцы деревьев и кустарников Армении (Angiospermae. IX. *Rosaceae*. Роды *Amelanchier, Amygdalus, Armeniaca*, *Cerasus, Cotoneaster*). С помощью светового (СМ) и сканирующего электронного (SEM) микроскопов изучена пыльца 15 видов деревьев и кустарников Армении из родов *Amelanchier* Medik., *Amygdalus* L., *Armeniaca* Mill., *Cerasus* Juss., *Cotoneaster* Medik. (сем. *Rosaceae* Juss.)

Морфология пыльцы, деревья, кустарники, СМ, СЭМ

The results of investigation of pollen morphology of 15 representatives of Armenian trees and shrubs relating to the genera *Amelanchier* Medik., *Amygdalus* L., *Armeniaca* Mill., *Cerasus* Juss., *Cotoneaster* Medik. (family *Rosaceae* Juss.) are 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).

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: ***Amelanchier*** *ovalis* Medic (= *A. rotundifolia* (Lam.) Dum.): Армения, область Гегаркуник, полуостров Артаниш, выше развалин, можжевеловое редколесье (Armenia, Gegarkunik region, Artanish peninsula, above the ruins, juniper woodlands). Leg. V. Manakyan (ERE, 149804); АрмССР, Гукасянский район, Ленинакан - Амасия. Leg. Я. Мулкиджанян (ArmSSR, Gukasyan district, Leninakan - Amasia. Leg. Ya. Mulkidzhanyan) (ERE, 78971); ***Amygdalus*** *communis* L.: Израиль, Иерусалим, Каталон. Leg. Э. Габриэлян (Israel, Jerusalem, Catalon. Leg. E. Gabrielyan) (ERE, 77512); *A. fenzliana* (Fritsch) Lipsky: АрмССР, Иджеванский район, между селами Иджеван х Узунтала, правый борт реки Акстев, редколесье. Leg. Я. Мулкиджанян (ArmSSR, Ijevan district, between the villages Ijevan x Uzuntala, starboard side of the Akstev river, light forest. Leg. Ya. Mulkidzhanyan) (ERE, 64424); *A. nairica* Fed. & Takht.: АрмССР, Мегринский район, окрестности Анкавана, на глинистых брекчиях. Leg. Э. Габриэлян, Г. Торосян (ArmSSR, Meghri district, vicinity of Ankavan, on clay breccias. Leg. E. Gabrielyan, G. Torosyan) (ERE, 117703); ***Armeniaca*** *vulgaris* Lam.*[1]: АрмССР, Ереванский Ботанический сад, участок “Армянской флоры”. Leg. В. Аветисян (ArmSSR, Yerevan Botanical Garden, “Armenian Flora” plot. Leg. V. Avetisyan) (ERE, 68357); ***Cerasus*** *avium* (L.) Moench: Армения, лиственный лес в окрестностях Караклиса. Leg. А. Б. Шелковников (Armenia, deciduous forest in

[1] * – cultivated spesies

the vicinity of Karaklis. Leg. A. B. Shelkovnikov) (ERE, 20802); АрмССР, Дилижанский заповедник, Дилижанское лесничество, дубово-грабовый лес, западный склон, 1300 м. Leg. Н. Мкртчян (ArmSSR, Dilijan Reserve, Dilijan Forestry, oak-hornbeam forest, western slope, 1300 m. Leg. N. Mkrtchyan) (ERE, 72825); *C. incana* (Pall.) Spach: АрмССР, Абовянский район, Гегарт, кустарниковый склон. Leg. А. Тахтаджян, Я. Мулкиджанян, Э. Габриэлян (ArmSSR, Abovyan region, Geghart, shrub slope. Leg. A. Takhtadzhyan, Ya. Mulkidzhanyan, E. Gabrielyan) (ERE, 100003); Армения, Ереванский Ботанический сад, участок "Армянской флоры". Leg. А. Айрапетян (личные сборы); (Armenia, Yerevan Botanical Garden, "Armenian Flora" plot. Leg. A. Hayrapetyan (personal collections); *C. mahaleb* (L.) Mill.: АрмССР, Кафанский район, Шикахохский заповедник, река Цав, правый берег. Leg. М. Григорян (ArmSSR, Kafan district, Shikakhokh reserve, Tsav river, right bank. Leg. M. Grigoryan) (ERE, 80946); Pr. Beiuk-Vedi, Chosrov. Leg. A. Schelkovnikov (ERE, 20829); *C. microcarpa* (C.A. Mey.) Boiss.: АрмССР, Мегри, Личк. Leg. Я. Мулкиджанян (ArmSSR, Meghri, Lichk. Leg. Ya. Mulkidzhanyan) (ERE, 80944); ***Cotoneaster*** *armenus* Pojark.: АрмССР, Котайкский район, окрестности монастыря Гегард, правый берег реки Азат. Leg. А. Тахтаджян, В. Аветисян, Э. Габриэлян, В. Агабабян (ArmSSR, Kotayk district, the vicinity of the Geghard monastery, the right bank of the Azat River. Leg. A. Takhtadzhyan, V. Avetisyan, E. Gabrielyan, V. Aghababyan); (ERE, 150238); АрмССР, Котайкский район, окрестности монастыря Гехард. Leg. А. Тахтаджян, Э. Габриэлян, В. Аветисян (ArmSSR, Kotayk district, the vicinity of the monastery Geghard. Leg. A. Takhtadzhyan, E. Gabrielyan, V. Avetisyan) (ERE, 107196); *C. integerrimus* Medik.: АрмССР, бассейн озера Севан, Чкаловка х Норашен, на скалах. Leg. Р. Карапетян (ArmSSR, Lake Sevan basin, Chkalovka x Norashen, on the rocks. Leg. R. Karapetyan) (ERE, 58011); АрмССР, Абовянский район, окрестности села Гехард. Leg. Я. Мулкиджанян (ArmSSR, Abovyan district, the vicinity of the Geghard village. Leg. Ya. Mulkidzhanyan) (ERE, 107211); *C. multiflorus* Bunge: АрмССР, Микоянский район, окрестности села Кавушуг. Leg. В. Аветисян, Э. Габриэлян, Р. Карапетян, Ш. Асланян (ArmSSR, Mikoyan district, the vicinity of the village Kavushug. Leg. V. Avetisyan, E. Gabrielyan, R. Karapetyan, S. Aslanyan) (ERE, 107161); *C. niger* (Thunb.) Fr.: АрмССР, Анийский район, Сарнахпюр, ущелье (ArmSSR, Ani district, Sarnakhpur, gorge). Leg. J. Mulkijanian (i. e. Ya. Mulkidzhanyan) (ERE, 80961); Минус, окрестности между селами Березовским и Шадринским. Leg. Ревердатто (Minus, the neighborhood between the Berezovsky and Shadrinsky villages). Leg. Reverdatto (ERE, 13919); *C. racemiflorus* (Desf.) K. Koch (= *C. suavis* auct. non Pojark.: fl. cauc., p.p.): Армения, Капанский район, шибляк у деревни Шикахох, левый склон ущелья "Оци кар". Leg. К. Таманян (Armenia, Kapan region, a shiblak near the village Shikahoh, the left slope of the "Otsi Kar" gorge. Leg. K. Tamanyan) (ERE, 148426); АрмССР, склон Ахмагана, выше села Тазкенд. Leg. С. Тамамшян, Ан. Федоров (ArmSSR, the slope of Ahmagan, above the village Tazkend. Leg. S. Tamamshyan, An. Fedorov) (ERE, 27119); *C. transcaucasicus* Pojark. (= *C. obovata* Pojark., non Wall. ex Dunn): Армения, Кафанский район, Бартасский заказник, Санаилу. Leg. М. Григорян (Armenia, Kafan District, Bartass Sanctuary, Sanailu. Leg. M. Grigoryan) (ERE, 107167).

RESULTS

ROSACEAE Juss.

The total number of genera in Armenia – 31.
The number of genera of trees and/or shrubs in Armenia – 17.

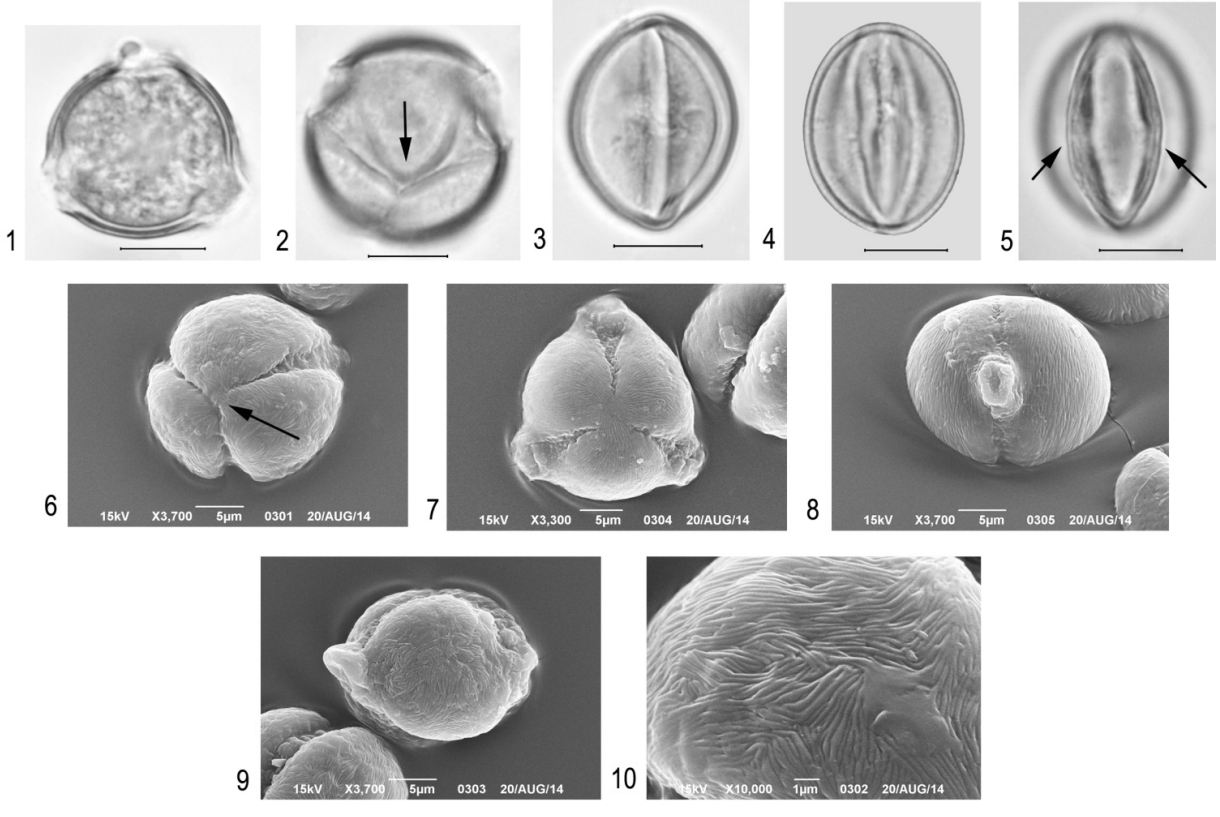
Amelanchier Medik.

Avetisyan, Manukyan, 1958; Kuprianova, Alyoshina, 1978; Kocon, Muszynski, 1982; Hebda et al., 1988; Hedba, Chinnappa, 1990; Jones et al., 1995; Gajewski et al., 2017

Shrubs 1-3 m tall. The number of species in Armenia – 1.

A. ovalis Medik. (= *A. rotundifolia* (Lam.) Dum.-Cours. nom. illeg.). (phototable I). Pollen grains 3-zonocolp-porate (poroidate), from oblong to oblate, outline in polar view rounded-triangular or rounded-3-lobed; polar axis 14,5-22,5 μm, equatorial diameter 17,4-20,3 μm. Colpi long,

with thickened edges and with pointed, sometimes anastomosing ends (synaperturate) (phototable I, 6); apocolpium diameter 2,5-4,5 μm, mesocolpium width 12,4-14,5 μm; ornamentation of colpus membrane granulate (SEM). Pores are not always clearly defined, elliptical, slightly elongated along the colpi, 5,1 μm x 3,5 μm. Exine 0,8-1,0 μm, columellae are not clearly defined. Exine ornamentation granulate (LM), exine ornamentation sinuously finely striate (SEM).



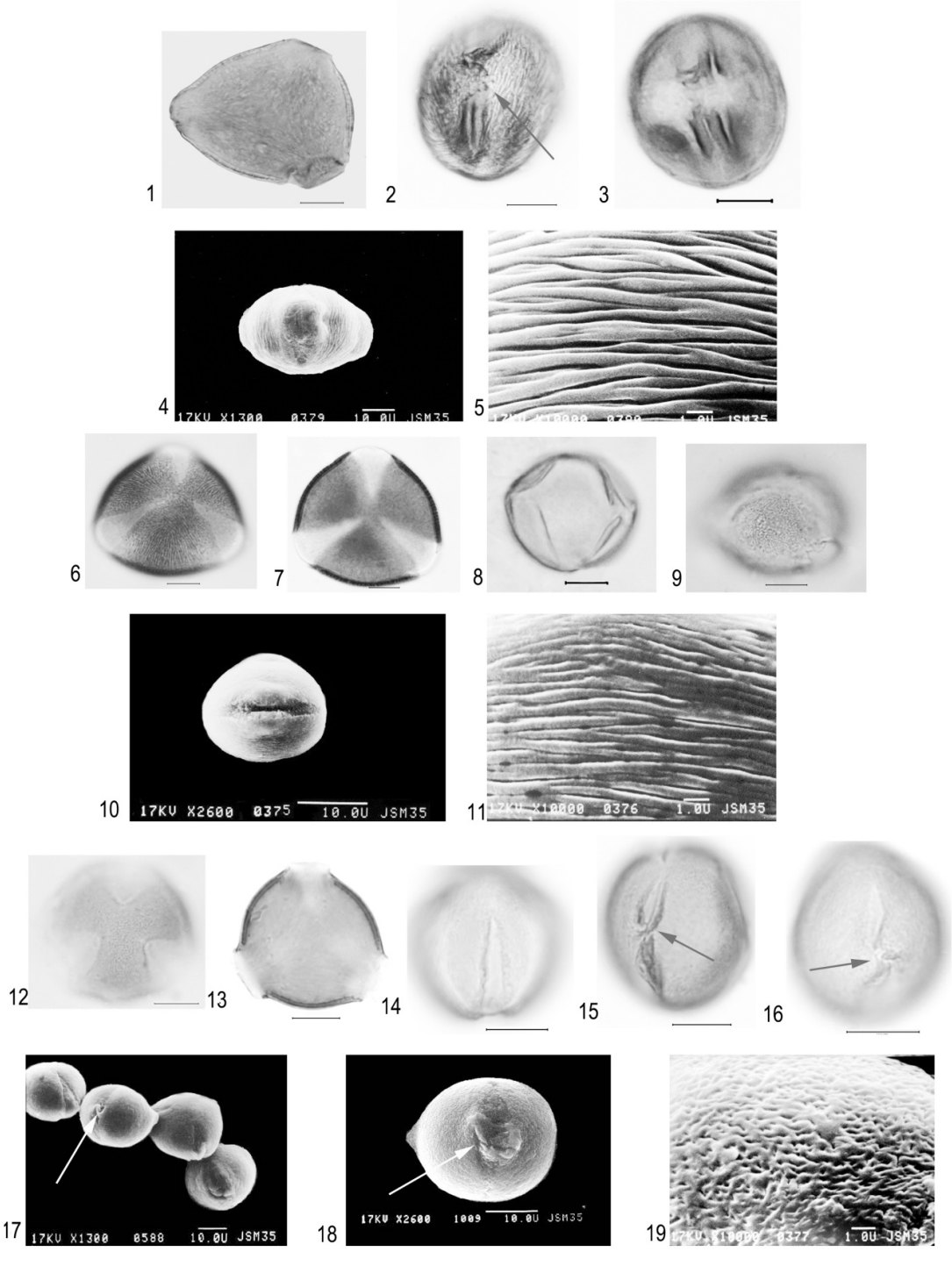
Phototable I. Pollen grains of *Amelanchier ovalis* Medik.
1, 2 – pollen grains from polar view (2 – synaperturate pollen grain, marked by arrow), 3-5 – pollen grains from equatorial view (5 – thickening of colpi edges, marked by arrows (LM), 6, 7 – pollen grains from polar view (6 – syncolporate pollen grain, marked by arrow), 8, 9 – pollen grains from equatorial view (8 – colpus, 9 – mesocolpium), 10 – exine ornamentation (SEM) (scale bar: 1-5 – 10 μm)

Amygdalus L.

Avetisyan, Manukyan, 1958; Demchenko, 1967; Soghomonyan, Abrahamyan, 1982; Vafadar et al., 2010; Perveen, Qaiser, 2014; Shi et al., 2013; Karpovich et al., 2015
(plate 1, phototable II)

Small trees or shrubs with frequently thorny branches. The number of species in Armenia – 3.

Pollen grains 3-zonocolp-porate (poroidate), from oblong to oblate, outline in polar view rounded-triangular or rounded-3-lobed; polar axis 18,5-27,0 μm, equatorial diameter 15,6-36,5 μm. Colpi predominantly not wide, average length or long (*A. fenzliana*), often with thickened edges (*A. communis* L., *A. nairica* Fed. & Takht.), the ends of the colpi blunt or slightly pointed (mainly), colpi membrane ornamentation granular; apocolpium diameter 2,5-10,2 μm, mesocolpium width 12,7-23,0 μm; for the species A. *communis* and *A. nairica* the presence of geniculua have been marked (phototable II, 2, 15-18). Pores elliptical, not always clearly defined, with uneven edges. Exine 1,3-1,5 μm, columellae thin, separated, regularly spaced. Exine ornamentation srtiate, striae short, often branched (*A. communis*) or striate, striate-reticulate (*A. fenzliana*) (LM, SEM); in *A. nairica*, exine ornamentation finely reticulate (LM), exine ornamentation perforate-finely plicate (SEM).



Phototable II. Pollen grains of some species of the genus *Amygdalus* L.
1-5 – A. *communis* L.: 1 – pollen grain from polar view, 2, 3 – pollen grains from equatorial view (2 – colpus with geniculum, marked by arrow) (LM), 4 – pollen grain from equatorial view (colpus), 5 – exine ornamentation (SEM); 6-11 – *A. fenzliana* (Fritsch) Lipsky: 6, 7 – pollen grains from polar view, 8, 9 – pollen grains from equatorial view (mesocolpium) (LM), 10 – pollen grain from equatorial view (colpus), 11 – exine ornamentation (SEM); 12-19 – *A. nairica* Fed. & Takht.: 12, 13 – pollen grains from polar view, 14 – pollen grain from semipolar view, 15, 16 – pollen grains from equatorial view (colpi with genicula, marked by arrows) (LM), 17, 18 – pollen grains from polar and equatorial view (colpi with geniculum, marked by arrows), 19 – exine ornamentation (SEM) (scale bar: 1-3, 6-9, 12-16 – 10 μm)

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

Species	Pollen grain size (P x E)[1] (μm	Colpus		Exine ornamentation	
		apocolpium diameter (μm)	mesocolpium width (μm)	LM	SEM
A. communis L.	22,7-27,0 x 22,8-36,5	8,1-9,8	12,7-15,5	striate, striae short, often branched	striate, striae short, often branched
A. fenzliana (Fritsch) Lipsky	18,5-23,4 x 15,6-27,0	2,5-3,5	15,5-21,0	striate, reticulate-striate	striate, reticulate-striate
A. nairica Fed. & Takht.	20,5-24,3 x 21,8-24,8	8,3-10,2	17,7-23,0	finely reticulate	perforate-finely plicate

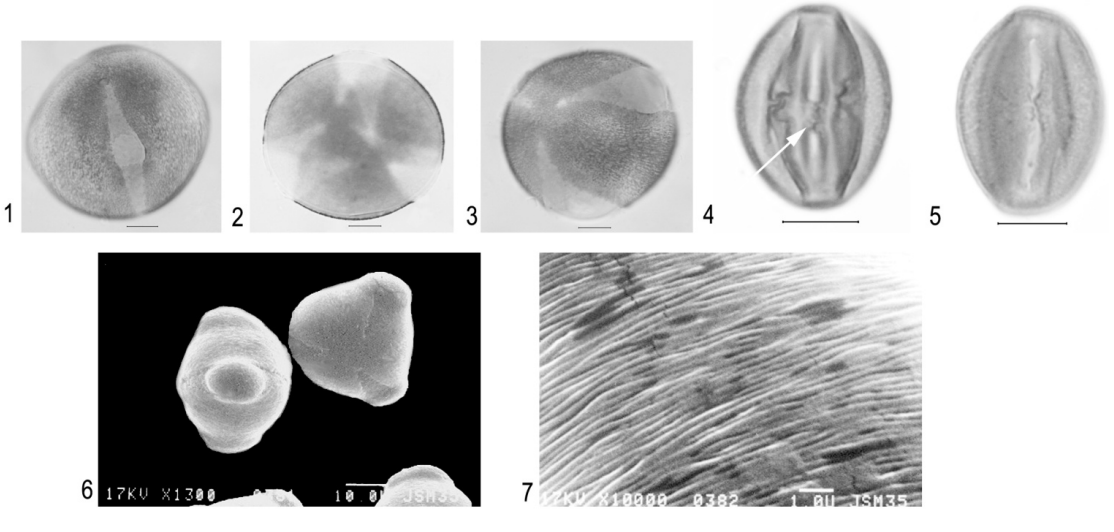
Armeniaca Mill.

Avetisyan, Manukyan, 1958; Demchenko, 1967; Arzani et al., 2005; Geraci et al., 2012; Perveen, Qaiser, 2014; Chwil, 2015

Trees. The number of species in Armenia – 1.

A. vulgaris Lam.* (phototable III). Pollen grains 3-zonocolp-porate, from oblong to oblate, outline in polar view rounded or rounded-triangular; polar axis 25,7-38,2 μm, equatorial diameter 21,7-37, 7 μm. Colpi long, with slightly uneven edges, sometimes geniculate (phototable III, 4), the ends rounded or slightly pointed, colpi membrane ornamentation granular; apocolpium diameter 8,6-10,8, mesocolpium width 17,3-24,8 μm. Pores almost circular, with uneven edges, pore diameter 7,5-9,8 μm. Exine 1,0-1,2 μm, columellae are not clearly defined. Exine ornamentation granulate-striate (LM), exine ornamentation srtiate, towards the equator turning into reticulate-srtiate (SEM).

A small percentage (5-10%) of variation in the size of pollen grains up to 1,5-1,6 times is noted.



Phototable III. Pollen grains of *Armeniaca vulgaris* Lam.

1 – pollen grains from equatorial view (colp-porate aperture), 2, 3 – pollen grains from semipolar view (3 – exine ornamentation), 4, 5 – pollen grains from equatorial view (4 – colpus with geniculum, marked by arrow) (LM), 6 – pollen grains from polar and equatorial view, 7 – exine ornamentation (SEM) (scale bar: 1-5 – 10 μm)

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

Cerasus Juss.

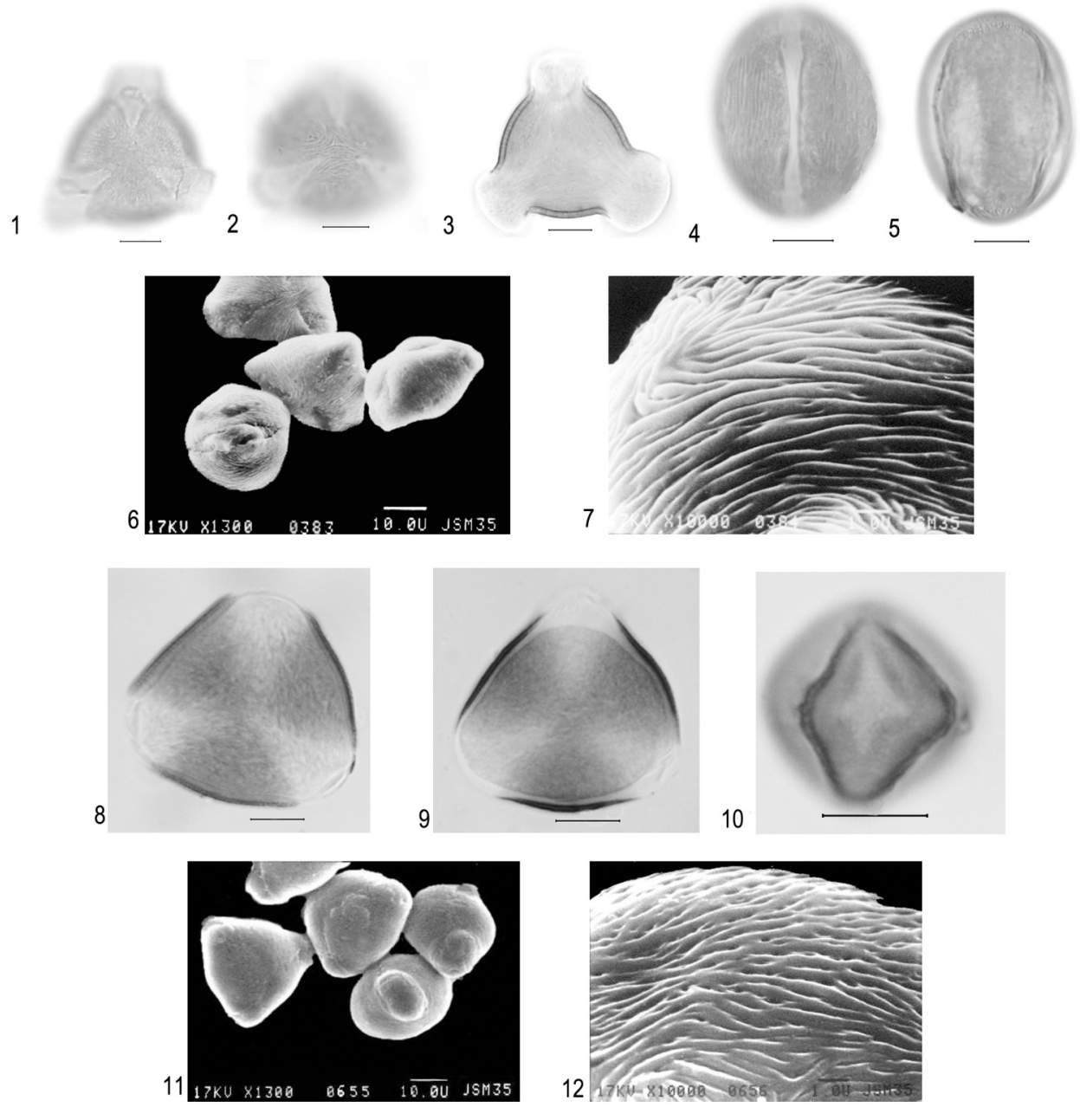
Avetisyan, Manukyan, 1958; Praglowski, 1962; Valdes et al., 1987; Geraci et al., 2012; Shi et al., 2013; Karpovich et al., 2015; Chwil, 2015 (plate 2, phototables IV, V)

Trees or shrubs.The number of species in Armenia – 5.

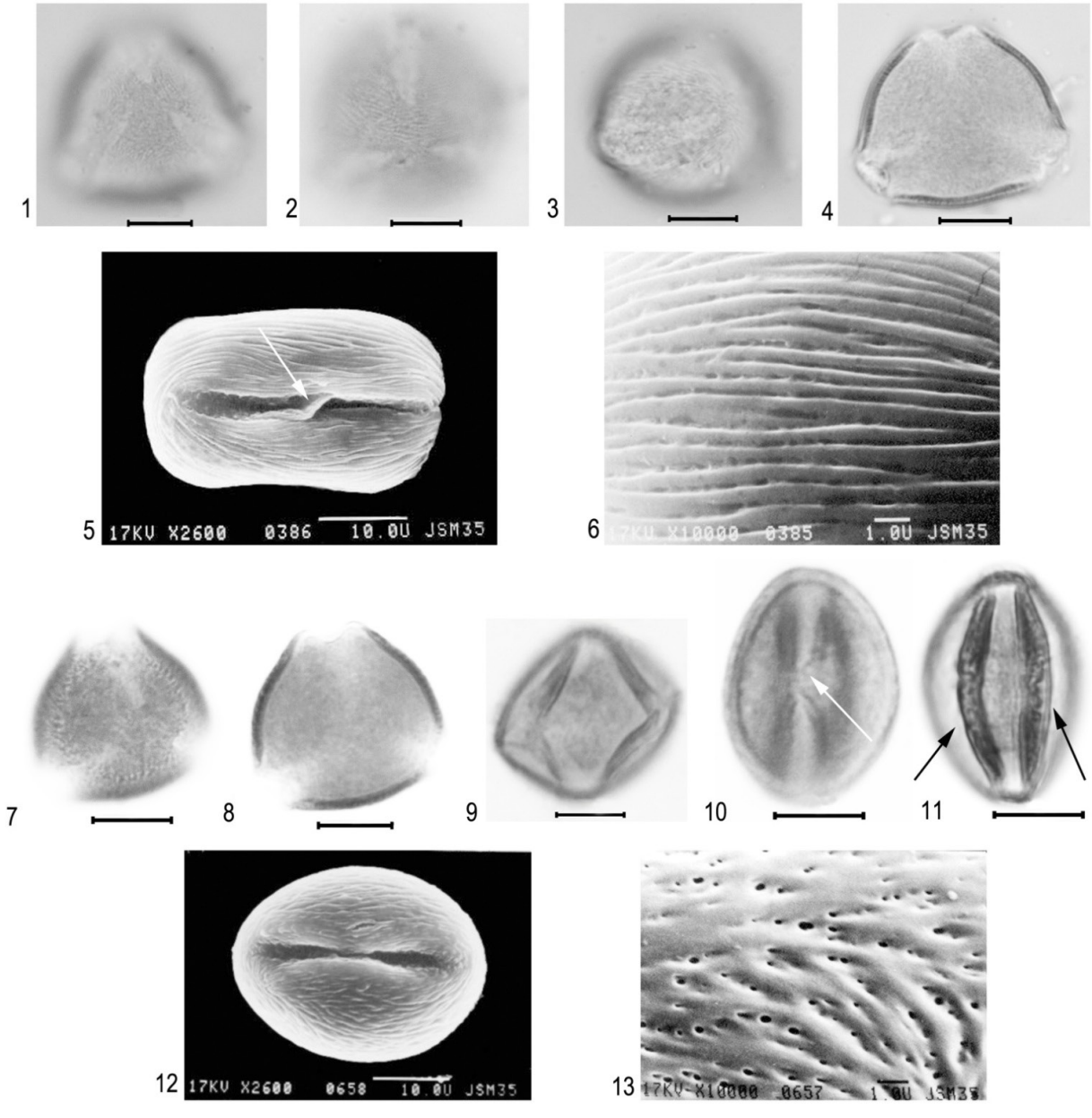
Pollen grains 3-zonocolpate, 3-zonocolp-poroidate (porate), from oblong to oblate, outline in polar view rounded-triangular or rounded-3-lobed; polar axis 16,1-30,5 μm, equatorial diameter 17,5-25,8 μm. Colpi of medium length or long, narrow, ends rounded or slightly pointed, along the colpi edges the thickening of the exine layer is observed (*C. microcarpa* (C.A. Mey.) Boiss.) (phototable V, 11), for this species, and *C. mahaleb* (L.) Mill. also the presence of geniculua have been marked (phototable V, 5, 10); apocolpium diameter 2,8-8,6 μm, mesocolpium width 12,7-21,0 μm. Pores, if present, almost circular, often feebly marked. Exine 1,0-1,2 μm, columellae are not clearly defined. Exine ornamentation is represented with variations of striate sculpture (LM, SEM) (plate 2).

Plate 2. Palynomorphological characteristics of some species of the genus *Cerasus* Juss.

Species	**Pollen grain size (P x E)** (μm	**Colpus**		**Exine ornamentation**	
		apocolpium diameter (μm)	**mesocolpium width** (μm)	**LM**	**SEM**
C. avium (L.) Moench	16,1-30,5 x 22,5-25,8	7,5-8,6	18,0-20,5	striate, striae long	striate, striae long
C. incana (Pall.) Spach	17,8-20,5 x 20,4-24,7	2,8-3,7	18,5-21,0	striate	perforate-striate
C. mahaleb (L.) Mill.	26,0-30,2 x 20,0-23,1	4,5-8,4	12,7-15,5	finely reticulate-striate	perforate-striate, striae long
C. microcarpa (C.A. Mey.) Boiss.	23,1-29,5 x 17,5-25,2	5,0-5,5	12,5-14,2	– // –	plicate-striate with perforations



Phototable IV. Pollen grains of some species of the genus *Cerasus* Juss.
1-7 – *C. avium* (L.) Moench: 1-3 – pollen grains from polar view, 4, 5 – pollen grains from equatorial view (4 – colpus, 5 – mesocolpium) (LM), 6 – pollen grains from polar and equatorial view, 7 – exine ornamentation (SEM); 8-12 – *C. incana* (Pall.) Spach: 8, 9 – pollen grains from polar view, 10 – pollen grain from equatorial view (LM), 11 – pollen grains from polar and equatorial view, 12 – exine ornamentation (SEM) (scale bar: 1-5, 8-10 – 10 μm)



Phototable V. Pollen grains of some species of the genus *Cerasus* Juss.
1-6 – *C. mahaleb* (L.) Mill.: 1, 2, 4 – pollen grains from polar view, 3 – pollen grain from semipolar view (LM), 5 – pollen grain from equatorial view (colpus with geniculum, marked by arrow), 6 – exine ornamentation (SEM); 7-13 – *C. microcarpa* (C.A. Mey.) Boiss.: 7, 8 – pollen grains from polar view, 9-11 – pollen grain from equatorial view (10 – colpus with geniculum and 11 – thickening of colpi edges, marked by arrows) (LM), 12 – pollen grain from equatorial view (colpus),
13 – exine ornamentation (SEM) (scale bar: 1-4, 7-11 – 10 μm)

Cotoneaster Medik.

Avetisyan, Manukyan, 1958; Demchenko, 1967; Kuprianova, Alyoshina, 1978; Eide, 1981; Hedba, Chinnappa. 1990; Perveen, Qaiser, 2014 (plate 3, phototables VI-VIII)

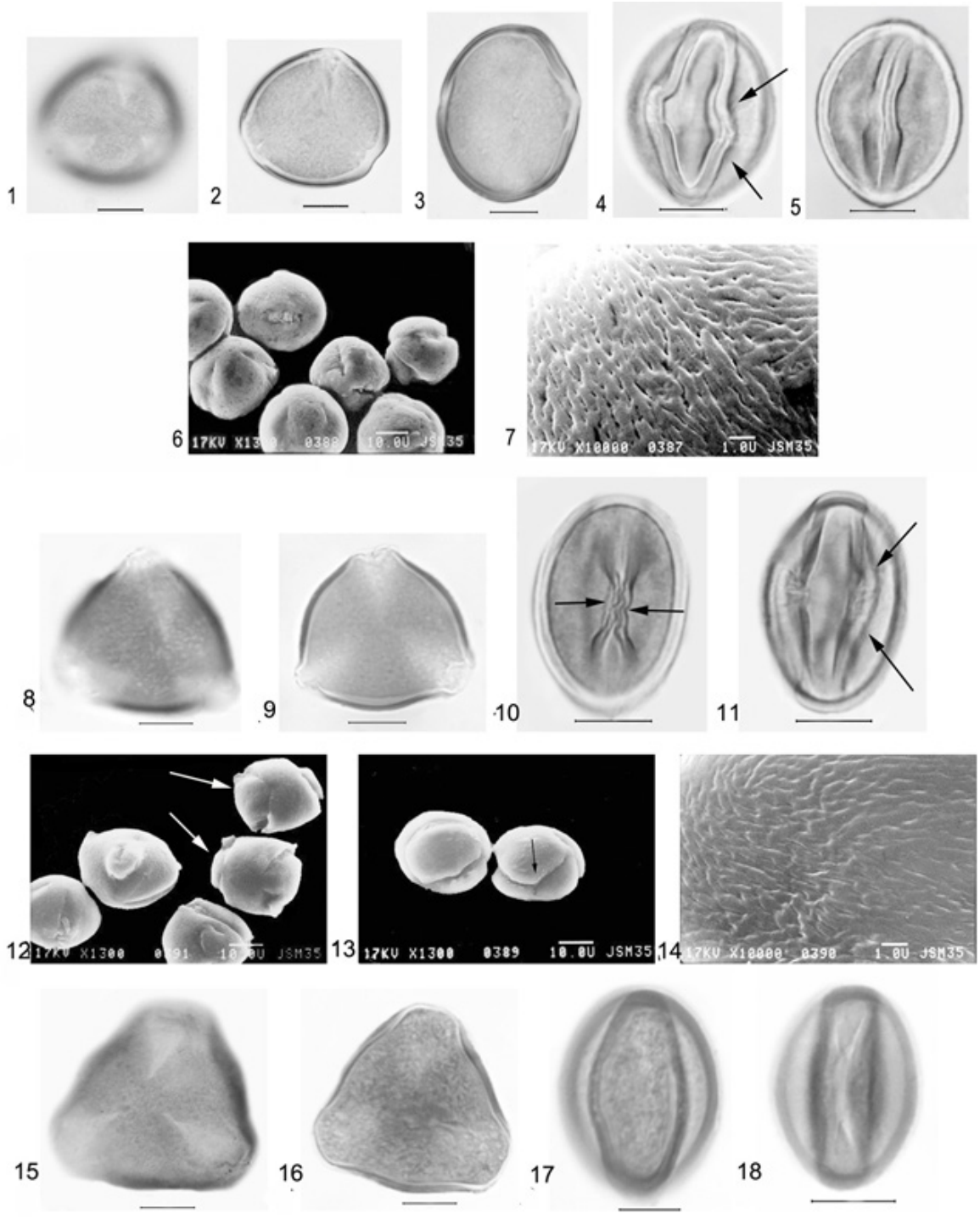
Shrubs. The number of species in Armenia – 10.

Pollen grains 3(4)-zonocolpate, 3-zonocolp-poroidate, sometimes with paracolpi (phototable VII, 5, 10, 12), from oblong to oblate, outline in polar view rounded-3(4)-angular or 3(4)-lobed; polar axis 16,5-32,3 μm, equatorial diameter 16,8-31,6. Colpi long, sometimes (*C. transcaucasicus* Pojark.) with anastomosing ends (synapeturate) (phototable VIII, 3, 4), often with thickened edges (phototable VI, 4, 11, phototable VII, 2, 13), ends rounded or slightly pointed, the presence of geniculua have been marked (phototable VI, 10, phototable VII, 1, 6, phototable VIII, 6); apocolpium diameter 3,5-10,2 μm, mesocolpium width 10,4-20,2 μm. Pores, if present, usually weakly expressed. Exine 1,5-1,8 μm, columellae are not clearly defined. Exine ornamentation is represented with variations of striate or reticulate sculptures (LM, SEM).

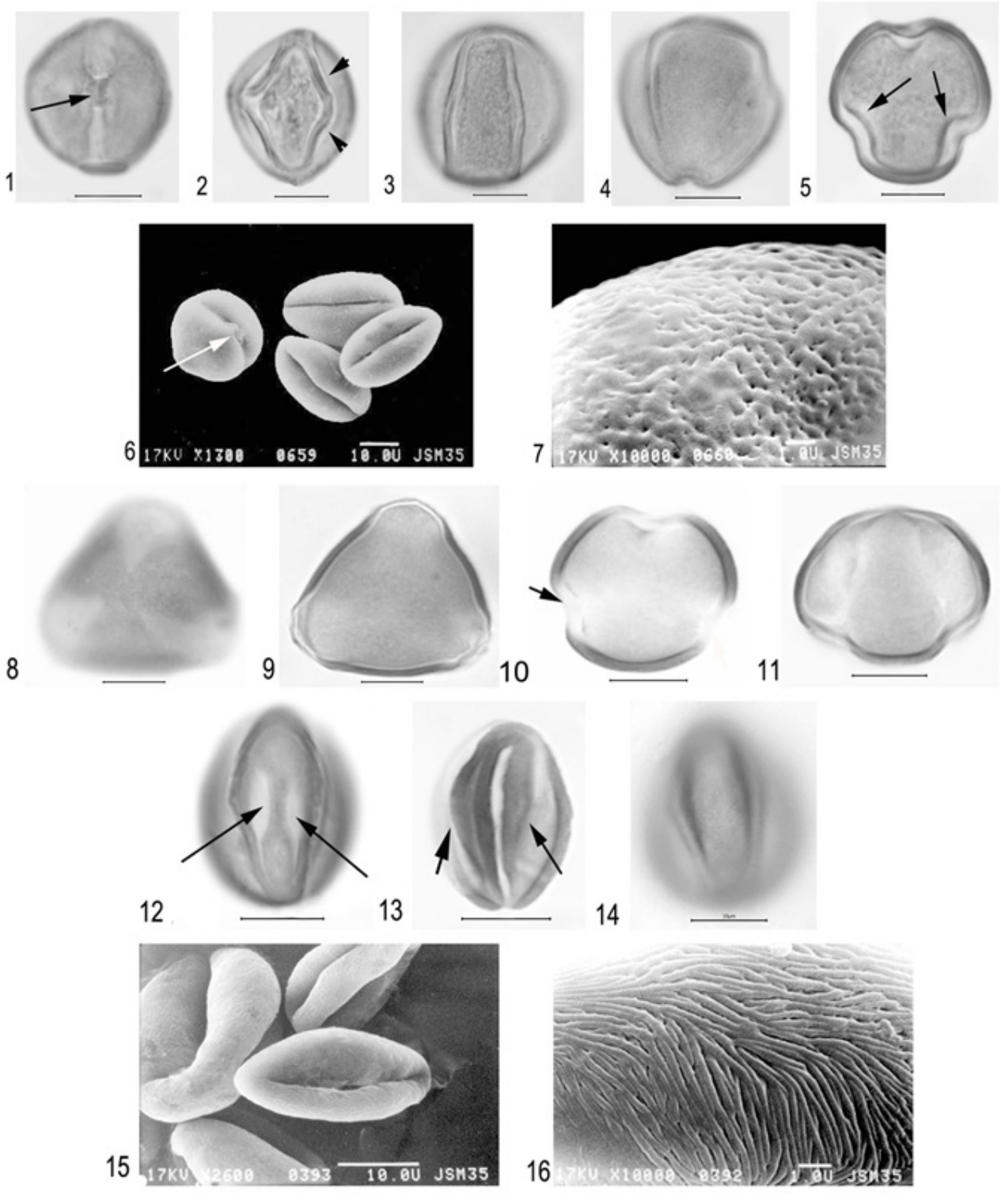
Plate 3. Palynomorphological characteristics of some species of the genus *Cotoneaster* Medik.

Species	Pollen grain size (P x E) (μm)	Colpus		Exine ornamentation	
		apocolpium diameter (μm)	mesocolpium width (μm)	LM	SEM
C. armenus Pojark.	19,4-32,3 x 21,1-28,5	5,1-8,2	12,9-15,0	striate, striae short	perforate-striate, striae short
C. integerrimus Medik.	18,9-29,5 x 17,6-22,8	5,5-10,2	12,8-18,4	finely reticulate	perforate-finely striate
C. multiflorus Bunge	23,6-30,4 x 16,8-24,8	7,5-8,2	18,2-20,2	finely reticulate -striate	–
C. niger (Thunb.) Fr. (= *C. melanocarpus* Fisch. ex Loudon)	16,5-23,4 x 14,8-23,2	3,5-3,8	10,4-14,8	finely reticulate	perforate-finely reticulate
C. racemiflorus (Desf.) Booth. ex Bosse (= *C. suavis* auct. non Pojark.: fl. cauc., p.p.)	22,4-25,8 x 12,5-22,8	5,5-7,5	10,8-15,4	- // -	perforate-finely striate
C. transcaucasicus Pojark. (= *C. obovata* Pojark., non Wall. ex Dunn)	18,5-23,6 x 25,7-31,6	4,5-6,5	12,3-15,8	- // -	perforate-sinuously striate, striae short

1 L. A. Kupriyanova, L. A. Alyoshina (1978) characterized the pollen of some representatives of the genus *Cotoneaster* as 3 (4)-colp-orate or 3 (4)-colp-pore-orate (*C. integerrimus* Medik.), with weakly expressed pores and oras with "wing-shaped dentate lateral edges "(p. 30). Our studies do not confirm the presence of the os in 6 species studied, including the species indicated above. As for the bright areas in the microphotographs of pollen grains from the polar view (Phototable VII, 5, 10), resembling oras, in our opinion, they are the polar projections of the paracolpi, clearly visible on microphotograph 12 (phototable VII).

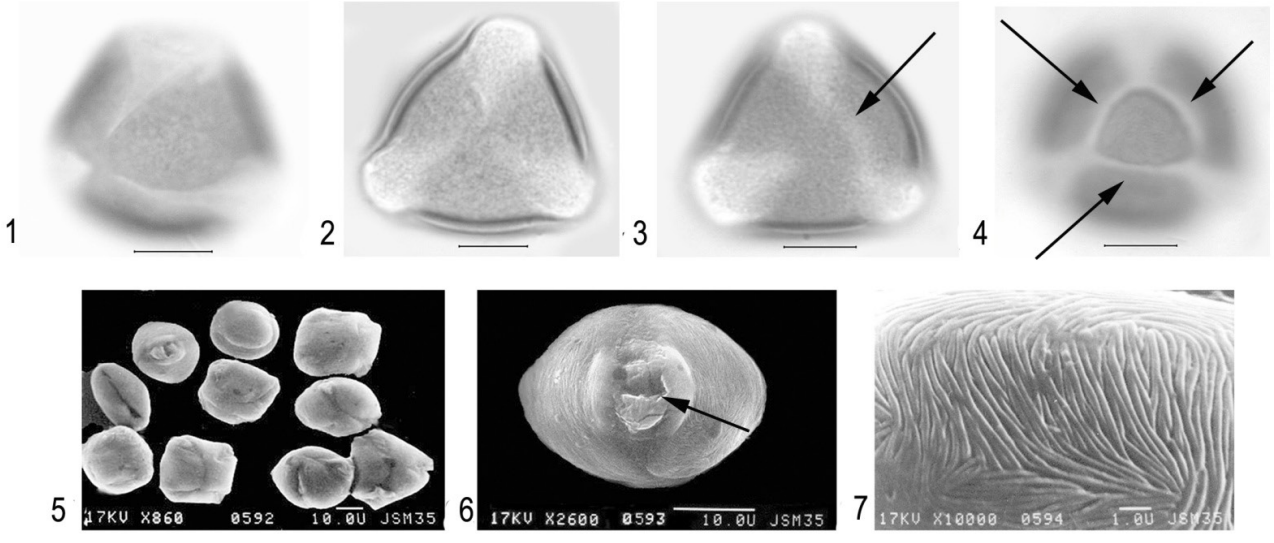


Phototable VI. Pollen grains of some species of the genus *Cotoneaster* Medik.
1-7 – *C. armenus* Pojark.: 1, 2 – pollen grains from polar view, 3-5 – pollen grains from equatorial view (3 – mesocolpium, 4, 5 – colpus, 4 – thickening of colpi edges, marked by arrows) (LM), 6 – pollen grains from polar and equatorial view, 7 – exine ornamentation (SEM); 8-14 – *C. integerrimus* Medik.: 8, 9 – pollen grains from polar view, 10, 11 – pollen grains from equatorial view (colpus, 10 – geniculum and 11 – thickening of the colpi edges, marked by arrows), 12, 13 – pollen grains from polar and equatorial view (12 – 4-aperturate pollen grains and 13 – synaperturate pollen, marked by arrows), 14 – exine ornamentation (SEM); 15-18 – *C. multiflorus* Bunge: 15, 16– pollen grains from polar view, 17, 18– pollen grains from equatorial view (mesocolpium) (LM)
(scale bar: 1-5, 8-11, 15-18 – 10 μm)



Phototable VII. Pollen grains of some species of the genus *Cotoneaster* Medik.

1-7 – *C. niger* (Thunb.) Fr.: 1-3 – pollen grains from equatorial view (1 – colpus with geniculum and 2 – thickening of colpi edges, marked by arrows, 3 – mesocolpium), 4 – pollen grain from semipolar view, 5 – pollen grain from polar view with paracolpi (marked by arrows) (LM), 6 – pollen grains from equatorial view (geniculum, marked by arrow), 7 – exine ornamentation (SEM); 8-16 – *C. racemiflorus* (Desf.) K. Koch: 8-10 – pollen grains from polar view (10 – pollen grain with paracolpi, marked by arrow), 11-14 – pollen grains from equatorial view (12 – paracolpi and 13 – thickening of colpi edges, marked by arrows) (LM), 15 – pollens grains, general view, 16 – exine ornamentation (SEM) (scale bar: 1-5, 8-14 – 10 μm)



Phototable VIII. Pollen grains of the species *Cotoneaster transcaucasicus* Pojark.
1- pollen grain from semipolar view, 2-4 – pollen grains from polar view (3, 4 – synaperturate pollen grains, marked by arrows) view (LM), 5 – pollen grains, general view, 6 – pollen grain from equatorial view (geniculum, marked by arrow), 7 – exine ornamentation (SEM) (scale bar: 1-4 – 10 μm)

ACKNOWLEDGEMENTS

This study was conducted with the financial support NEF (Nagao Natural Environment Foundation, Japan).

REFERENCES

Arzani K., Nejatian M. A., Karimzadeh G.. 2005. Apricot (*Prunus armeniaca*) pollen morphological characterization through scanning electron microscopy, using multivariate analysis // New Zeal. J. Crop. Hort., 33: 381–388.

Avetisyan E. M., Manukyan L. K. 1958. Description of the pollen of *Buxaceae, Grossulariaceae, Platanaceae, Rosaceae* // Flora of Armenia, 3 (ed. Takhtajan A. L.). Yerevan. 387 p. (in Russ.) (Аветисян Е. М., Манукян Л. К. 1958. Описание пыльцевых зерен сем. *Buxaceae, Grossulariaceae, Platanaceae, Rosaceae* // Флора Армении, 3. Ереван. 387 с.).

Chwil M. 2015. Micromorphology of pollen grains of fruit trees of the genus *Prunus* // Acta Sci. Pol.-Hortoru., 14, 4: 115-129.

Demchenko N. I. 1967. Palynological data on the taxonomy and phylogeny of *Rosaceae* // Abstract of Cand. Diss., Odessa. 18 pp. (in Russ.) (Демченко Н. И. 1967. Палинологические данные к систематике и филогении розоцветных // Автореф. канд. дисс., Одесса.18 с.).

Eide, F. 1981. Key for Northwest European Rosaceae pollen // Grana, 20: 101-118.

Gajewski K., Vetter M., Paquette N.. 2017. Pollen Atlas of Arctic and Boreal Canada. AASP Foundation. 241 p.

Geraci A., Polizzano V., Marino P., Schicchi R. 2012. Investigation on the pollen morphology of traditional cultivars of *Prunus* species in Sicily // Acta Soc. Bot. Pol., 81, 3: 175–184.

Hebda R. J., Chinnappa C. C., Smith B. M.. 1988. Pollen morphology of the *Rosaceae* of Western Canada. 1. *Agrimonia* to *Crataegus* // Grana, 27: 95-113.

Hedba R., Chinnappa C.C.. 1990. Studies on pollen morphology of *Rosaceae* in Canada // Acta Bot. Gallica: bulletin de la Société botanique de France, 64, 1: 103-108.

Jones, G. D., Bryant, V. M., Jr., Lieux, M. H., Jones, S. D., Lingren, P. D. 1995. Pollen of the southeastern United States: with emphasis on melissopalynology and entomopalynology. Dallas, TX: Am. Assoc. Stratigr. Palynol. Found., 30. 76 pp. (+ 104 plates).

Karpovich I. V., Drebezgina Ye. S., Elovikova E. A, Legotkina G. I., Zubova E. N., Kuzyaev R. Z., Khismatullin R. G. 2015. Atlas of pollen grains. The Ural worker: Yekaterinburg. 318 p. (+ 288 plates) (in Russ.) (Карпович И. В., Дребезгина

Е. С., Еловикова Е. А., Леготкина Г. И., Зубова Е. Н., Кузяев Р. З., Хисматуллин Р. Г. 2015. Атлас пыльцевых зерен (Pollen atlas). Уральский рабочий: Екатеринбург. 318 с. (+ 288 илл.)).

Kocon J., Muszynski S. 1982. Ultrastructure of pollen grain sculpturing in several species of the *Rosaceae* family // Acta Soc. Bot. Pol., 51(3-4): 341-344.

Kuprianova L. A., Alyoshina L. A. 1978. Pollen and spores of plants from the flora of European part of the USSR. 2. Lamiaceae-Zygophyllaceae. «Nauka», Leningrad. 184 pp. (in Russ.) (Куприянова Л. А., Алешина Л. А. 1978. Пыльца двудольных растений флоры Европейской части СССР. Л.183 с.).

Perveen A., Qaiser M. 2014. Pollen flora of Pakistan – LXXI. *Rosaceae* // Pak. J. Bot., 46, 3: 1027-1037.

Praglowski J. R. 1962. Notes on the pollen morphology of Swedish trees and shrubs // Grana Palynologica, 3, 2: 45-65.

Shi W., Wen J., Lutz S. 2013. Pollen morphology of the *Maddenia* clade of *Prunus* and its taxonomic and phylogenetic implications // J. Syst. Evol., 51, 2: 164-183.

Soghomonyan, S. A., Abrahamyan, L. Kh. 1982. Ultrastructure of the sporderm of fertile and sterile pollen grains of *Amygdalus communis* L. // Biolog. Journ. of Armenia, 35, 3: 165-169 (in Russ.) (Согомонян, С. А., Абрамян, Л. Х. 1982. Ультраструктура спородермы фертильных и стерильных пыльцевых зерен *Amygdalus communis* L. // Биолог. журн. Армении, 35, 3: 165-169).

Valdés B., Díez M. J., Fernandes I. 1987. Atlas polinico de Andalucia Occidental. Universidad de Sevilla. 451p.

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