

A. M. HAYRAPETYAN

**POLLEN OF TREES AND SHRUBS OF ARMENIA
(ANGIOSPERMAE. VII. *Salicaceae*, *Sapindaceae*,
Smilacaceae, *Solanaceae*, *Staphyleaceae*, *Tamaricaceae*)**

With the help of light (LM) and scanning electron (SEM) microscopes investigations of pollen morphology of 32 species of Armenian trees and shrubs from the families *Salicaceae* Mirb., *Sapindaceae* Juss., *Smilacaceae* Vent., *Solanaceae* Juss., *Staphyleaceae* Lindl., *Tamaricaceae* Link. have been carried out.

Pollen morphology, trees, shrubs, LM, SEM

Հայրապետյան Ա.Մ. Հայաստանի ծառերի և թփերի ներկայացուցիչների ծաղկափոշու ուսումնասիրությունը (Angiospermae. VII. *Salicaceae*, *Sapindaceae*, *Smilacaceae*, *Solanaceae*, *Staphyleaceae*, *Tamaricaceae*): Լուսային (ԼՄ) և սկաներային էլեկտրոնային (ՍԷՄ) մանրադիտակների օգնությամբ ուսումնասիրվել է Հայաստանի դեղինփղորայի *Salicaceae* Mirb., *Sapindaceae* Juss., *Smilacaceae* Vent., *Solanaceae* Juss., *Staphyleaceae* Lindl., *Tamaricaceae* Link. ընտանիքներին պատկանող 32 տեսակների ծաղկափոշու մորֆոլոգիան:

Ծաղկափոշու մորֆոլոգիա, ծառեր, թփեր, ԼՄ, ՍԷՄ

Айрапетян А.М. Морфология пыльцы деревьев и кустарников Армении (Angiospermae. VII. *Salicaceae*, *Sapindaceae*, *Smilacaceae*, *Solanaceae*, *Staphyleaceae*, *Tamaricaceae*). С помощью светового (СМ) и сканирующего электронного (СЭМ) микроскопов изучена пыльца 32 видов деревьев и кустарников Армении из семейств *Salicaceae* Mirb., *Sapindaceae* Juss., *Smilacaceae* Vent., *Solanaceae* Juss., *Staphyleaceae* Lindl., *Tamaricaceae* Link.

Морфология пыльцы, деревья, кустарники, СМ, СЭМ

The results of investigation of pollen morphology of 32 representatives of Armenian trees and shrubs relating to the families *Salicaceae* Mirb., *Sapindaceae* Juss., *Smilacaceae* Vent., *Solanaceae* Juss., *Staphyleaceae* Lindl., *Tamaricaceae* Link. 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) 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:

SALICACEAE Mirb.: *Populus alba* L.: Армения, Ереван, Ботанический сад. Leg. Я. Мулкиджанян (Armenia, Yerevan, Botanical garden. Leg. Leg. Ya. Mulkidjanian); Россия, Томская область, берег реки Томь, около села Спасское. Leg. П. Крылов (ERE, 47400) (Russia, Tomsk region, bank of the river Tom, near the village Spasskoye. Leg. P. Krylov) (ERE, 47400); Transcaucasia Cic., Tiflis. Leg. A. Grossheim (LE); **P. bolleana** Lauche: АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. x canescens** (Ait.) Smith.: Prov. Dagestan, distr. Kurinskij, inter st. Bilidshi et Kullar, in silvis. Leg. Alexeenko (LE); АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. deltoides** Marsh.: АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. euphratica** Oliv.: АрмССР, Ереванский Бот. сад. Участок живой флоры. Leg. Э. Габриэлян (Armenian SSR, Yerevan Bot. garden. Plot of living flora. Leg. E. Gabrielian) (ERE, 109972); АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. gracilis** Grossh.: АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. nigra** L.: АрмССР, Ереванский Бот. сад, тополевая аллея. Leg. В. Манакян (Armenian SSR, Yerevan Bot. garden, poplar alley. Leg. V. Manakyan) (ERE, 82828); АрмССР, Ереванский Бот. сад. Leg. J. Mulkidjanian (Armenian SSR, Yerevan Bot. garden, poplar alley. Leg. J. Mulkidjanian) (ERE 81904); АрмССР, Ереван, Ботанический сад. Leg. Е. Аветисян (Armenian SSR, Yerevan, Botanical Garden. Leg. E. Avetisyan); **P. tremula** L.: Армения, Араилер, сев. склон, выс. 2300 м. Leg. Асатрян А. Т. (личные сборы) Armenia, Arailer, northern slope, 2300 m. Leg. A. T. Asatryan (personal fees); **Salix aegyptiaca** L.: Армения, Кафанский район, Шикахогский заповедник, платановая роща. Leg. М. Григорян (Armenia, Kafan district, Shikakhog nature reserve, plane tree grove. Leg. M. Grigoryan) (ERE, 82319); АрмССР, Ереван, Ботанический сад. Leg. Е. М. Аветисян; **S. alba** L.: АрмССР, Ереван, Давиташен, ущелье реки Раздан. Leg. V. Manakyan (Armenian SSR, Yerevan, Davtashen, gorge of the river Hrazdan. Leg. V. Manakyan) (ERE, 105835); **S. caprea** L.: АрмССР, Алавердский район, село Ахкерпи, сев. склон над селом. Leg. V. Manakyan (Armenian SSR, Alaverdi district, village Akhkerpi, northern slope above the village. Leg. V. Manakyan) (ERE, 74182); **S. excelsa**

S. G. Gmel.: АрмССР, Арташатский район, Урцский заповедник, село Асни. Leg. Я. Мулкиджанян (Armenian SSR, Artashat district, Urts Reserve, Asni village. Leg. Ya. Mulkidjanian) (ERE, 82832); Армения, Мегринский район, Вартанадзор и Маралзам. Leg. Э. Габриэлян, В. Агабабян (Armenia, Meghri region, Vartanadzor and Maralzam. Leg. E. Gabrielyan, V. Agababyan) (ERE, 66609); **S. pentandroides** A. Skvorts.: Турция, Карс, близ Саракамьша, у родника. Leg. Д. Литвинов (Turkey, Kars, near Sarakamysh, near a spring. Leg. D. Litvinov) (ERE, 42121); **S. purpurea** L. (syn. *S. elbursensis* Boiss.): АрмССР, Дилижанский заповедник, Дилижанское лесничество, северо-западный склон. Leg. Н. Мкртчян (Armenian SSR, Dilijan Reserve, Dilijan Forestry, north-western slope. Leg. N. Mkrтчyan) (ERE, 70612); **S. triandra** L.: АрмССР, Наирыйский район, окрестности села Ерзнка, на сухих каменистых склонах. Leg. Э. Габриэлян (Armenian SSR, Nairi district, the neighborhood of the village of Yerznka, on the rocky slopes. Leg. E. Gabrielian) (ERE, 110315); Армения, Агаракстрой, берег реки Аракс. Leg. Ц. Давтян (Armenia, Agarakstroy, bank of the Araks river. Leg. Ts. Davtyan) (ERE, 92776); **S. wilhelmsiana** M. Bieb.: АрмССР, Арташатский район, окрестности Джанатлу, берег реки Азат. Leg. А. Тахтаджян, Я. Мулкиджанян, Э. Габриэлян, В. Аветисян (Armenian SSR, Artashat district, surroundings of Dzhanatlu, Azat river bank. Leg. A. Takhtajan, Ya. Mulkidjanian, E. Gabrielyan, V. Avetisyan) (ERE, 121872);

SAPINDACEAE Juss.: **Koelreuteria paniculata** Lam.: Армения, Ереван, ул. Кочара. Leg. А. Барсегян (Armenia, Yerevan, Kochar str. Leg. A. Barseghyan) (ERE, 173490); Армения, область Тавуш, Иджеван, поля в окрестностях поворота в деревню Акнахбюр. Leg. И. Аревшатян (Armenia, Tavush region, Ijevan, fields in the vicinity of the turn to Aknakhbyur village. Leg. I. Arevshatyan) (ERE, 173489);

SMILACACEAE Vent.: **Smilax excelsa** L.: Армения, Иджеванский район, правый борт реки Агстев. Leg. Я. Мулкиджанян (Armenia, Ijevan district, right side of the Agstev river. Leg. Ya. Mulkidjanian) (ERE, 113944); Черноморский округ, Сочи, Хлудовская сторона. Leg. W. Steup (Black Sea District, Sochi, Khludovskaya side. Leg. W. Setup) (ERE, 13111);

SOLANACEAE Juss.: **Lycium anatolicum** A. Baytop et R. Mill.: Армения, Мегринский район, Гудемнис х Вагравар, редколесье. Leg. Я. Мулкиджанян, П. Гандилян, А. Барсегян (Armenia, Meghri region, Gudemnis x Vagravar, light forest. Leg. Ya. Mulkidjanian, P. Gandilyan, A. Barseghyan) (ERE, 118165); Prope Djulfa (ad fl. Arax). Leg. A. Schelkownikow et K. M. (ERE, 23519); **L. barbarum**

L.: Армения, Туманянский район, окрестности села Ахпат. Leg. Э. Габриэлян (Armenia, Tumanyan district, neighborhood of the village of Haghpat. Leg. E. Gabrielian) (ERE, 113960); **L. depressum** Stocks: Армения, Мегринский район, Мегри-Зангезур. Leg. В. Аветисян (Armenia, Meghri region, Meghri-Zangezur. Leg. V. Avetisyan) (ERE, 110509); Армения, Мегринский район, пойма реки Аракс, близ села Мегри. Leg. А. Барсегян (Armenia, Meghri region, floodplain of the Araks river, near the village of Meghri. Leg. A. Barseghyan) (ERE, 113873); **L. ruthenicum** Murray: Distr. Nachitshevan inter Dzulfa et Aza. Leg. A. Grossheim (ERE, 138074); Distr. Nachitshevan, pr. Dzulfa, Leg. A. Grossheim (ERE, 23521); **L. turkomanicum** Turcz. ex Miers (syn. *L. depressum* Stocks): АрмССР, г. Мегри, берег реки Аракс, между Мегри и Карчеваном. Leg. Э. Габриэлян, П. Гамбарян (Armenian SSR, Meghri, the bank of the Araks river, between Megri and Karchevan. Leg. E. Gabrielyan, P. Gambaryan) (ERE, 88092); **Solanum dulcamara** L.: АрмССР, Ереван, ущелье реки Гедар. Leg. А. Барсегян (Armenian SSR, Yerevan, Gedar river gorge. Leg. A. Barsegian) (ERE, 100764); Армения, Ani distr., near Anipemza, on the ruins of Ezerujk basilica (ERE, 181162); АрмССР, Егегнадзорский район, окрестности села Арпа, скалы. Leg. Я. Мулкиджанян (Armenian SSR, Yeghegnadzor district, the neighborhood of the village Arpa, rocks. Leg. Ya. Mulkidjanian) (ERE, 79893);

STAPHYLEACEAE Lindl.: **Staphylea pinnata** L.: АрмССР, Ноемберянский район, Ламбалинский лесхоз, Садахлинское лесничество, грабовый лес. Leg. А. Карапетян (Armenian SSR, Noyemberyan district, Lambalu forestry, Sadakhlo forest range, hornbeam forest. Leg. A. Karapetyan) (ERE, 58989); АрмССР, Кировакан, Бот. сад. Leg. Э. Габриэлян, А. Янкун (ArmССР, Kirovakan, Bot. garden. Leg. E. Gabrielyan, A. Yankun) (ERE, 108445); АрмССР, Иджеванский район, село Севкар. Leg. Я. Мулкиджанян, В. Манакян (Armenian SSR, Idjevan district, village Sevkar. Leg. Ya. Mulkidjanian, V. Manakyan) (ERE, 81192);

TAMARICACEAE Link.: **Myricaria alopecuroides** Schrenk.: Армения, Иджеванский район, Севкарский лес, промхоз, ущелье Киранц, вверх по левому борту реки. Leg. Я. Мулкиджанян, В. Манакян (Armenia, Ijevan district, Sevkar forest, industrial farm, Kirants gorge, upstream on the left side of the river. Leg. Ya. Mulkidjanian, V. Manakyan) (ERE, 81359); **T. florida** Bunge: АрмССР, Мегри, Ньюади, отроги Мегринского хребта. Сухое русло. Leg. В. Манакян (Armenian SSR, Megri, Nuvadi, spurs of the Megri Ridge. Dry track. Leg. V. Manakyan) (ERE, 78210); Distr. Nachitshevan,

inter Djulfa et Darosham. Leg. A. Grossheim (ERE, 23616); *T. hohenackeri* Bunge: АрмССР, Арташатский район, массив Еранос, внутреннее ущелье в районе плотины. Фригана. Leg. А. Тахтаджян, Э. Габриэлян, Я. Мулкиджанян, В. Аветисян, А. Погосян (Armenian SSR, Artashat district, Yeranos mountain range, inland gorge area of the dam. Frigana. Leg. A. Takhtajan, E. Gabrielyan, J. Mulkidjanian, V. Avetisyan, A. Poghosyan) (ERE, 69728); Армения, Мегринский район, склоны гор над селом Ньюади, арчевое редколесье. Leg. Э. Габриэлян (Armenia, Meghri region, mountain slopes above the village of Nuvadi, juniper woodlands. Leg. E. Gabrielian) (ERE, 81377); *T. kotschyi* Bunge: АрмССР, окрестности села Зовашен, вдоль канала по левому берегу реки Азат, ниже плотины. Leg. Н. Гохтуни, В. Манакян (Armenian SSR, near the village of Zovashen, along the canal on the left bank of the Azat River, below the dam. Leg. N. Goghtuni, V. Manakyan) (ERE, 104755); *T. litwinowii* Gorschk.: Армения, Октемберян х село Айгерлич (Эчмиадзинский район), солянковая пустыня. Leg. А. Кронквист, Я. Мулкиджанян, А. Тахтаджян (Armenia, Hoktemberyan х Aigerlich village (Echmiadzin district), Salsola type desert. Leg. A. Cronquist, Ya. Mulkidjanian, A. Takhtajan) (ERE, 104758); АрмССР, Ереван, Аванское шоссе, ущелье реки Гедар. Leg. Л. Арутюнян (Armenian SSR, Yerevan, Avan Highway, Gedar river gorge. Leg. L. Harutyunyan) (ERE, 81355); *T. meyeri* Boiss.: АрмССР, окрестности села Араздаян. Leg. Н. Гохтуни (Armenian SSR, near the village of Arazdayan. Leg. N. Gokhtuni) (ERE, 125181); *T. octandra* Bunge: АрмССР, Вединский район, Урский хребет, выше села Суренаван. Leg. Я. Мулкиджанян, А. Погосян (Armenian SSR, Vedi district, Urts ridge, above the village Surenavan. Leg. Ya. Mulkidjanian, A. Poghosyan) (ERE, 110357); *T. ramosissima* Ledeb.: Армения, Араратский район, окрестности поселка Арарарт. Leg. Э. Габриэлян (Armenia, Ararat region, neighborhood of Ararart village. Leg. E. Gabrielian) (ERE, 113944); Туркменская ССР, Дейнауусский район. Leg. А. Аширова (Turkmen SSR, Deinaus district. Leg. A. Ashirova) (ERE, 37336); *T. smyrnensis* Bunge: АрмССР, станция Масис х Кархун, на засоленных местах. Leg. А. Тахтаджян, Э. Габриэлян, В. Аветисян, А. Погосян (Armenian SSR, Masis х Karhun station, on saline areas. Leg. A. Takhtajan, E. Gabrielyan, V. Avetisyan, A. Poghosyan)

(ERE, 69729); АрмССР, Дарелегис, берег реки Арпа. Leg. А. Тахтаджян, Э. Габриэлян, В. Агабабян, А. Погосян (Armenian SSR, Darelegis, bank of the river Arpa. Leg. A. Takhtajan, E. Gabrielyan, V. Agababyan, A. Poghosyan) (ERE, 69752).

RESULTS

SALICACEAE Mirb.

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

Populus L.

Radzevich, 1950; Jonas, 1952; Erdtman, 1954; Erdtman et al., 1961; Praglowski, 1962; Куприянова, 1965; Avetisyan, Manukyan, 1966; Rowley & Erdtman, 1967; Richard, 1970b; Myachina et al., 1971; Bassett et al., 1978; Kuprianova, Alyoshina, 1978; Ryabkova, 1987; Valdes et al., 1987; Trigo & Fernández, 1994; Jones et al., 1995; Beug, 2004; Tokarev, 2004; Дзюба, 2005; Карпович и др., 2015; Gajewski et al., 2017; Kai-Qing Lu et al., 2018

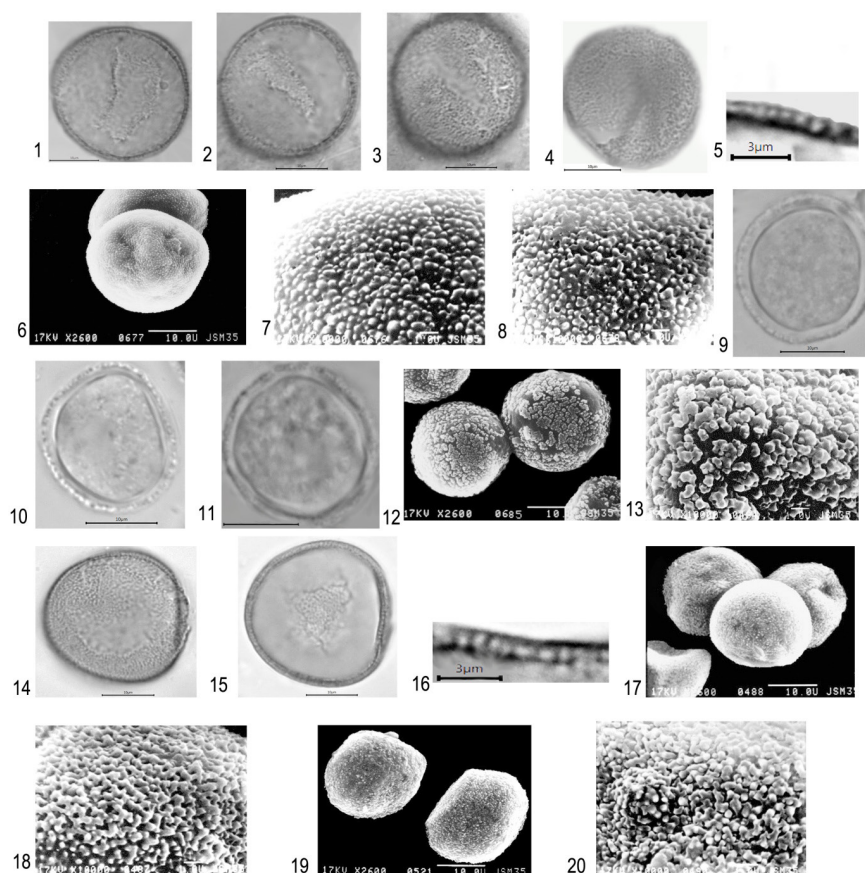
(plate 1, phototable I)

Large deciduous trees. The number of species in Armenia – 12.

Pollen grains are inaperturate, spheroidal or irregular-spheroidal, often with a plica on the surface; diameter of the pollen grain varies from 22,0 to 30,5 μm . Exine 1,3-1,5 μm , columellae separate, regularly spaced, enlarged at the base and towards the ends (LM). Exine ornamentation is granulate, granules of various sizes and shapes, on the surface of pollen grains there are separate zones devoid of sculptural elements (phototable I, 3) (LM); exine ornamentation is perforate-echinate or perforate-granulate; sometimes (*P. euphratica*) sculptural elements brought together, forming separate groups (phototable I, 13); in *P. nigra*, perforation is replaced with a fine reticulum (phototable. I, 18), in *P. tremula* spinate or verrucate elements are slightly elongated and curved (phototable I, 20) (SEM).

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

Species	Pollen grain diameter (µm)	Exine ornamentation	
		LM	SEM
<i>P. alba</i> L.	25,5-30,5	granulate	perforate-granulate-finely verrucate
<i>P. bolleana</i> Lauch	24,7-27,0	–//–	-
<i>P. x canescens</i> (Ait.) Smith	26,6-28,6	–//–	perforate-echinate
<i>P. deltoides</i> Marsh.	27,3-28,5	–//–	-
<i>P. euphratica</i> Oliv.	23,2-25,0	–//–	sculptural elements brought together, forming separate groups
<i>P. gracilis</i> Grossh.	22,0-25,5	–//–	-
<i>P. nigra</i> L.	25,5-30,1	–//–	echinate-finely reticulate
<i>P. tremula</i> L.	23,6-26,5	–//–	perforate-echinate (verrucate)

Photatable I. Pollen grains of some species of the genus *Populus* L.

1-7 – *P. alba* L. (1-4 – overall view, 5 – exine (LM), 6 – overall view, 7 – (SEM));

8 – *P. x canescens* (Ait.) Smith. (exine ornamentation (SEM)), 9-13 – *P. euphratica* (9-11 – overall view (LM), 12 – overall view, 13 – exine ornamentation (SEM)); 14-18 – *P. nigra* (14-15 – overall view, 16 – exine (LM), 17 – overall view, 18 – exine ornamentation (SEM));

19-20 – *P. tremula* (19 – overall view, 20 – exine ornamentation (SEM))

(scale bar: 1-4, 10-11, 14-15 – 10 µm)

***Salix* L.**

Radzevich, 1950; Jonas, 1952; Erdtman, 1954; Erdtman et al., 1961; Praglowski, 1962; Kuprianova, 1965; Avetisyan, Manukyan, 1966; Richard, 1970b; Myachina et al., 1971; Surova, 1975; Rowley, Erdtman, 1967; Bassett et al., 1978; Kuprianova, Alyoshina, 1978; Ryabkova, 1987; Valdes et al., 1987; Kezina, 1988; Trigo & Fernández, 1994; Jones et al., 1995; Sekina et al., 1995; Wang & Chen, 2002; Willard et al., 2004; Beug, 2004; Tokarev, 2004; Dzyuba, 2005; Petruk, 2009; Babayi et al., 2012; Karpovich et al., 2015; Gajewski et al., 2017

(plate 2, phototables II, III)

Trees or shrubs. The number of species in Armenia – 13.

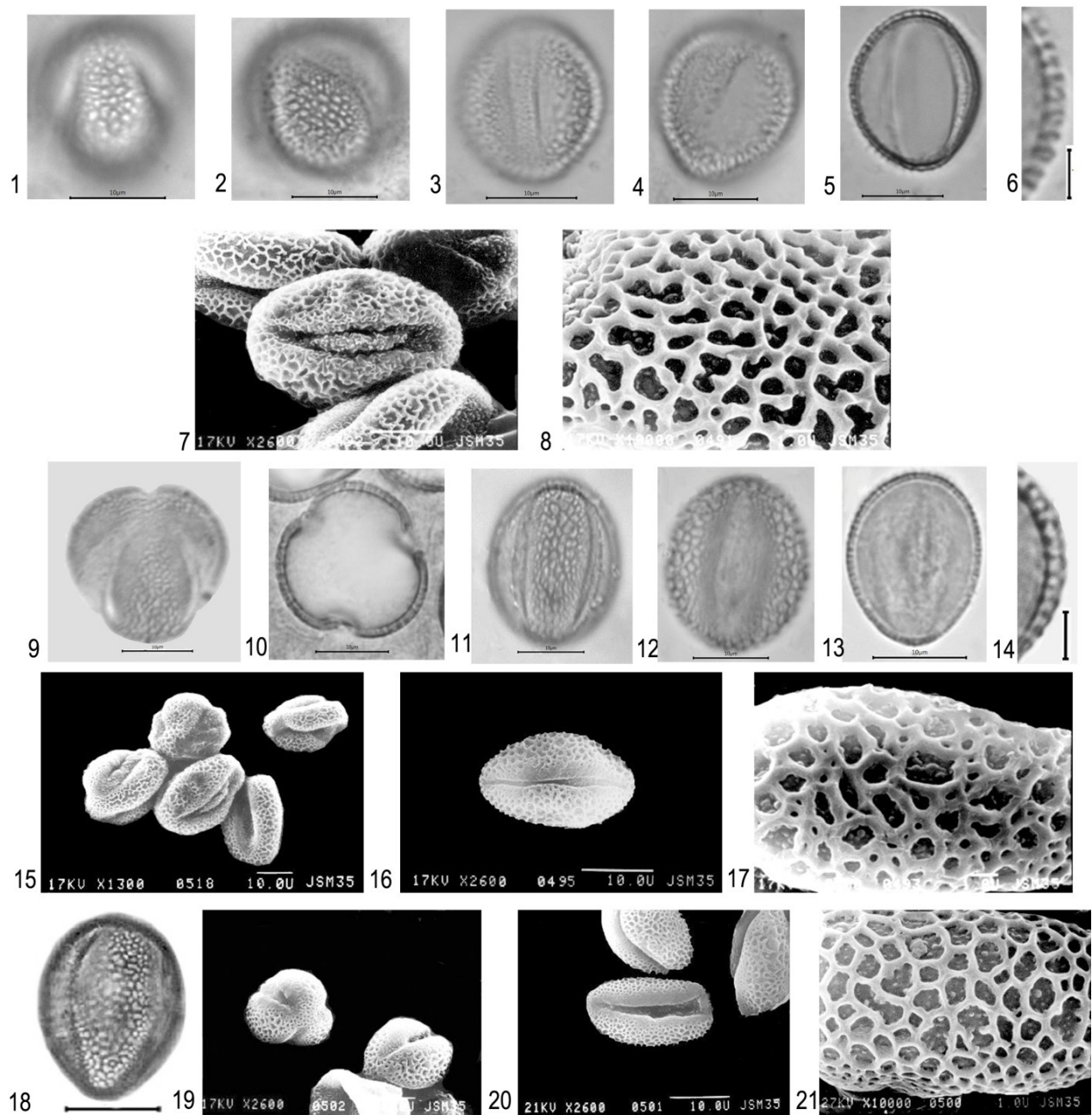
Pollen grains are 3-zonocolpate, rarely 3-zono-

colp-porate (poroidate) (*S. triandra* L., *S. wilhelmsiana* M. Bieb.), oblong (wide or narrow), in *S. wilhelmsiana* M. Bieb. almost spheroidal; in polar view the outline is roundish-3-lobed; polar axis 12,9-37,8 µm, equatorial diameter 10,1-28,2 µm, or 12.7-13.5 in diameter (*S. wilhelmsiana*). Colpi are of medium length (*S. alba* L.) or long, from narrow, almost slit-like to wide (even within the same sample), the ends are slightly rounded or pointed, colpus membrane is smooth or finely tubercular (LM); apocolpium diameter 2,4-5,1 µm, mesocolpium width 9,5-12,8 µm. Pores are elliptical, not always clearly defined, with uneven edges. Exine 1,2-1,3 µm, columellae separated, regularly spaced, enlarged towards the ends (LM). Exine ornamentation is reticulate, the size of the lumina decrease to the poles, as well as to the colpi (LM); exine ornamentation is irregularly reticular, densely arranged granules and verrucae are marked at the bottom of the lumina, sometimes lumina muri are interrupted (SEM).

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

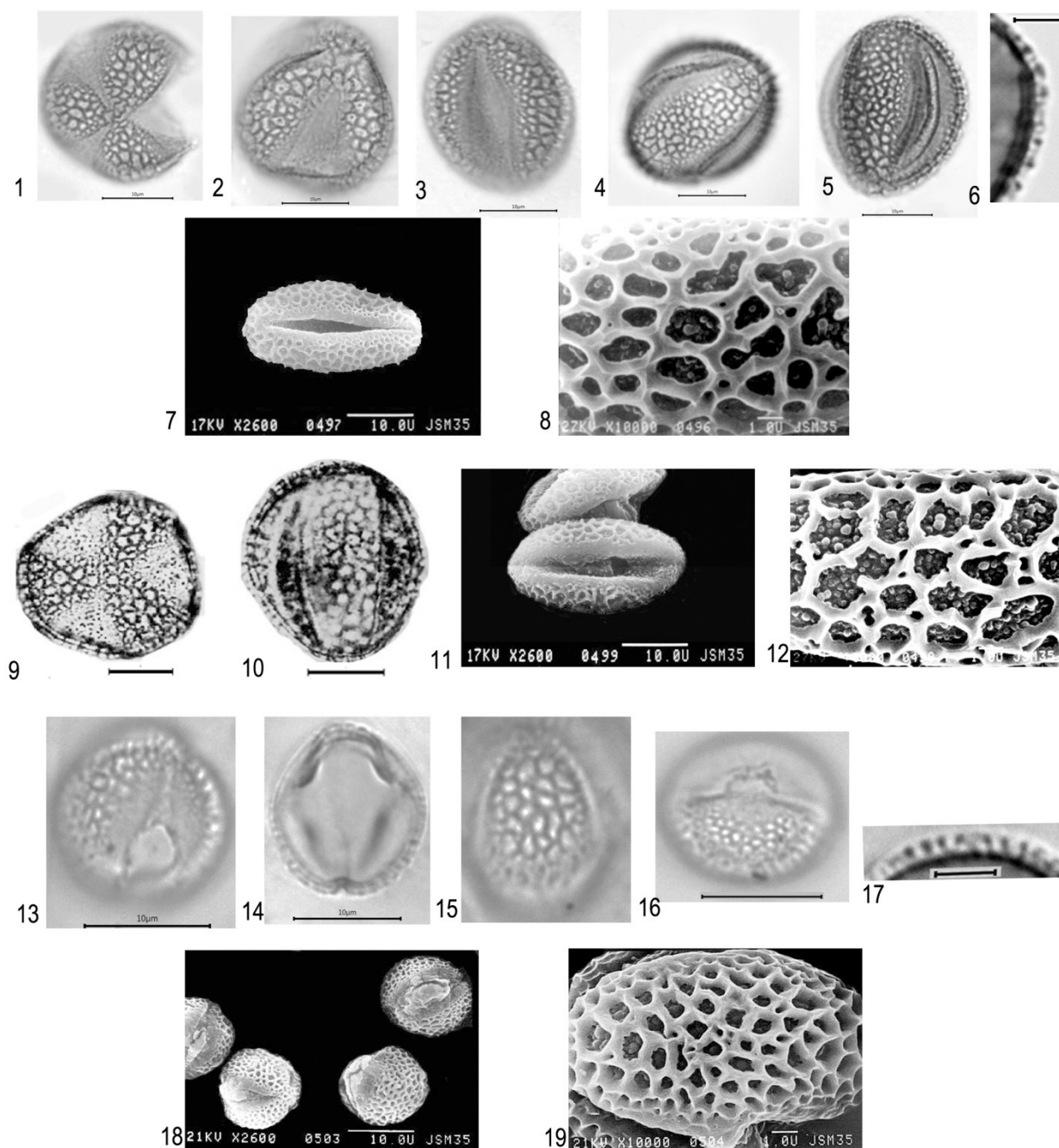
Species	Pollen grain size (P x E) ¹ (µm)	Colpus	
		apocolpium diameter (µm)	mesocolpium width (µm)
<i>S. aegyptiaca</i> L.	20,5-22,0 x 19,0-19,5	4,8-5,2	9,9-10,7
<i>S. alba</i> L.	22,5-37,8 x 17,9-22,5	6,5-7,0	8,6-10,0
<i>S. caprea</i> L.	22,6-27,2 x 12,6-17,7	6,8-7,3	10,2-11,4
<i>S. excelsa</i> S.G. Gmel.	22,5-28,2 x 15,0-19,5	2,1-2,6	12,2-13,5
<i>S. pentandroides</i> A. Skvorts.	25,9-29,3 x 15,0-23,6	4,1-5,3	10,2-12,8
<i>S. purpurea</i> L. (syn. <i>S. elbursensis</i> Boiss.)	18,7-24,5 x 12,6-15,7	4,2-5,3	10,1-11,5
<i>S. triandra</i> L.	18,0-18,9 x 16,2-16,8	2,8-3,5	11,3-12,6
<i>S. wilhelmsiana</i> M. Bieb.	12,9-13,5 x 10,1-12,0 or 12,7-13,5 in diam.	3,2-4,1	9,2-11,3

¹ P – polar axis, E – equatorial diameter



Phototable II. Pollen grains of some species of the genus *Salix* L.

1-8 – *S. alba* L. (1 – pollen grain from semipolar view, 2-5 – pollen grains from equatorial view, 6 – exine (LM), 7 – pollen grain from equatorial view (colpus), 8 – exine ornamentation (SEM)); 9-17 – *S. caprea* L. (9 – pollen grain from semipolar view, 10 – pollen grain from polar view, 11-13 – pollen grains from equatorial view, 14 – exine (LM), 15 – pollen grains from polar and equatorial view, 16 – pollen grain from equatorial view (colpus), 17 – exine ornamentation (SEM)); 18-21 – *S. purpurea* L. (syn. *S. elbursensis* Boiss.) (18 – pollen grain from equatorial view (mesocolpium), 19-20 – pollen grains from polar and equatorial view, 21 – exine ornamentation (SEM))
 (scale bar: 6, 14 – 3 μm , 1-5, 9-13, 18 – 10 μm)

Phototable III. Pollen grains of some species of the genus *Salix* L.

1-8 – *S. excelsa* S.G. Gmel. (1 – pollen grain from polar view, 2 – pollen grain from semipolar view, 3-5 – pollen grains from equatorial view, 6 – exine (LM), 7 – pollen grain from equatorial view (colpus), 8 – exine ornamentation (SEM)); 9-12 – *S. pentandroides* A. Skvorts. (9 – pollen grain from polar view, 10 – pollen grain from equatorial view (LM), 11 – pollen grain from equatorial view (colpus), 12 – exine ornamentation (SEM)); 13-19 – *S. wilhelmsiana* M. Bieb. (13-16 – pollen grain from equatorial view (13 – colpus with pore), 17 – exine (LM), 18 – pollen grains from polar and equatorial view, 19 – exine ornamentation (SEM))
(scale bar: 6, 17 – 3 μ m, 1-5, 9-10, 13-16 – 10 μ m)

SAPINDACEAE Juss.

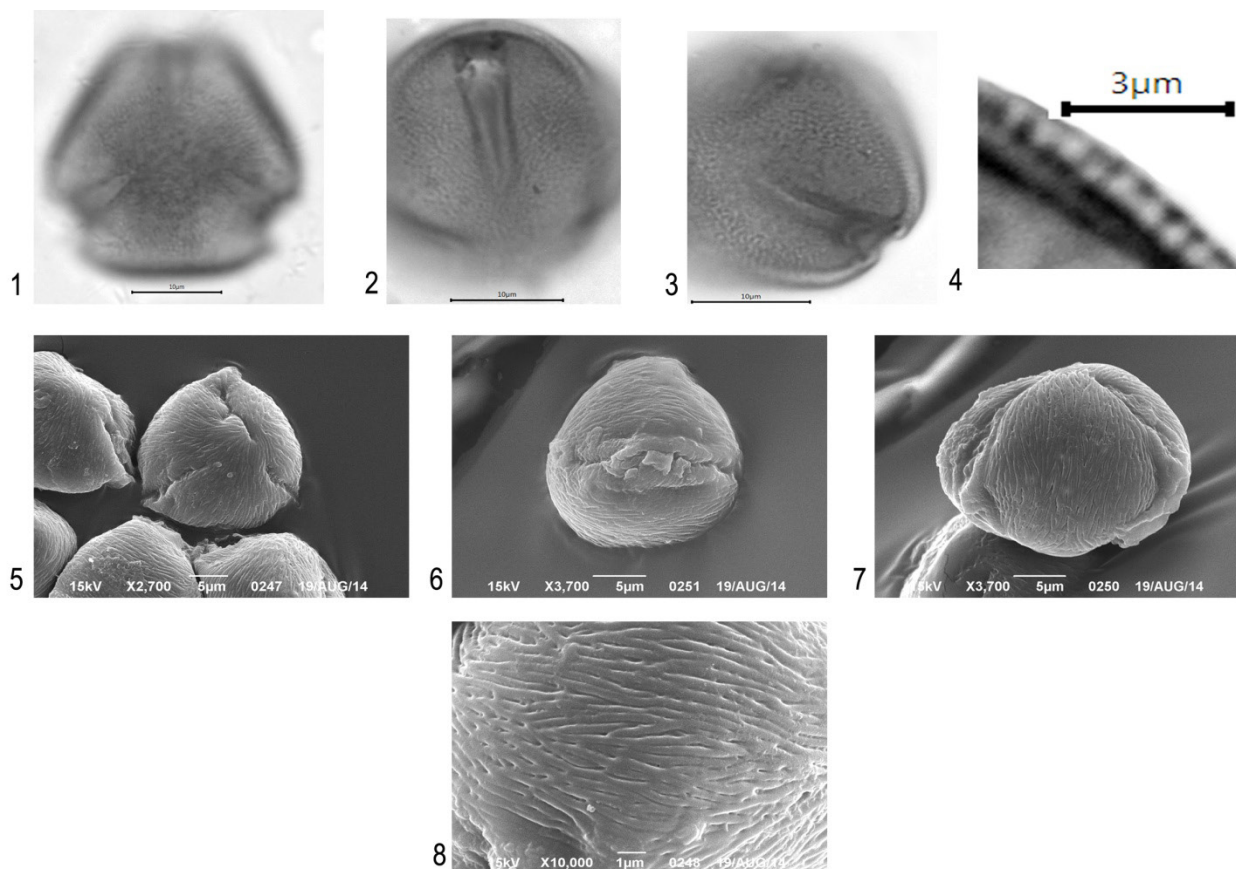
The total number of genera in Armenia – 1. The number of genera of trees and/or shrubs in Armenia – 1

Koelreuteria Laxm.

Meyer, 1976; Muller, Leenhouts, 1976; Acevedo-Rodriguez et al., 2011; Cao et al., 2016

K. paniculata Laxm. (phototable IV). Pollen grains are 3-zonocolp-orate, oblate in shape, in polar view

the outline is roundish-triangular; polar axis 14,5-15,8 μm , equatorial diameter 17,9-19,1 μm . Colpi are long, rather narrow, with slightly wavy edges, the ends are slightly rounded; along the edges as well as in the center of the colpi a thickening of the exine layer is observed (phototable IV, 2, 3); apocolpium diameter 6,8-7,5 μm , mesocolpium width 18,7-20,9 μm . Ora are small, slightly beyond the limits of the furrows, with almost parallel edges, the ends are diffuse. Exine 1,2-1,4 μm , columellae separate, rounded at the ends. Exine ornamentation is striate-finely reticulatae (LM); exine ornamentation is perforate-striate; striae often branched (SEM).



Phototable IV. Pollen grains of *Koelreuteria paniculata* Laxm.

1 – pollen grain from polar view, 2, 3 – pollen grain from semipolar view, 4 – exine (LM), 5 – pollen grain from polar view, 6-7 – pollen grain from equatorial view (6 – colpus, 7 – mesocolpium), 8 – exine ornamentation (SEM) (scale bar: 1-3 – 10 μm , 4 – 3 μm)

SMILACACEAE Vent.

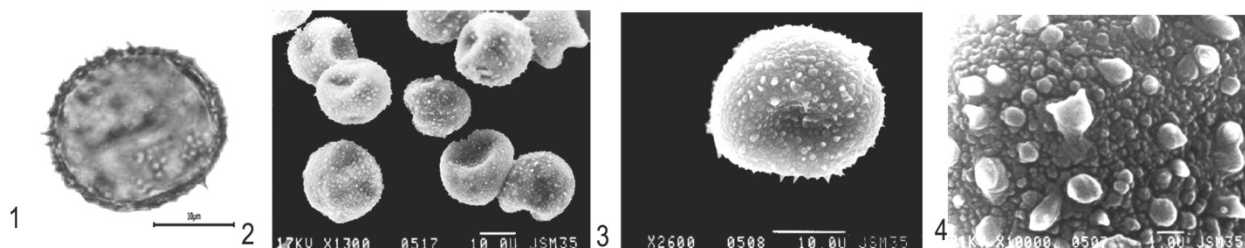
The total number of genera in Armenia – 1. The number of genera of trees and/or shrubs in Armenia – 1

Smilax L.

Erdtman, 1952; Bobrov et al., 1983; Valdes et al., 1987; Furness, Rudall, 1999; Beug, 2004; Ferrufino, Gymez-Laurito, 2004; Chen et al., 2006; Kodela, 2006; Furness et al., 2015

Climbing dioecious shrubs. The number of species in Armenia – 1.

S. excelsa L. (phototable V). Pollen grains are heads. Exine ornamentation is irregularly spinose and heteroverrucate between the spines (LM); exine ornamentation is irregular needly-spinose, granulate-verrucate between spines (SEM).



Phototable V. Pollen grains of *Smilax excelsa* L.

1 – overall view (LM), 2-3– overall view, 4 – exine ornamentation (SEM)

SOLANACEAE Juss.

The total number of genera in Armenia – 8. The number of genera of trees and/or shrubs in Armenia – 1

Lycium L.

Erdtman, 1952; Basak, 1967; Murry, Eshbaugh, 1971; Heusser, 1971; Kuprianova, Alyoshina, 1978; Punt, Monna-Brands, 1980; Аветисян, Мехакян, 1987; Valdes et al., 1987; El-Ghazaly, 1992; Jones et al., 1995; Sekina et al., 1995; Bernardello, Lujan, 1997; Cabrera, Cuadrado, 2007; Perveen, Qaiser, 2007; Hayrapetyan, 2008a, 2008b, 2008c, 2010

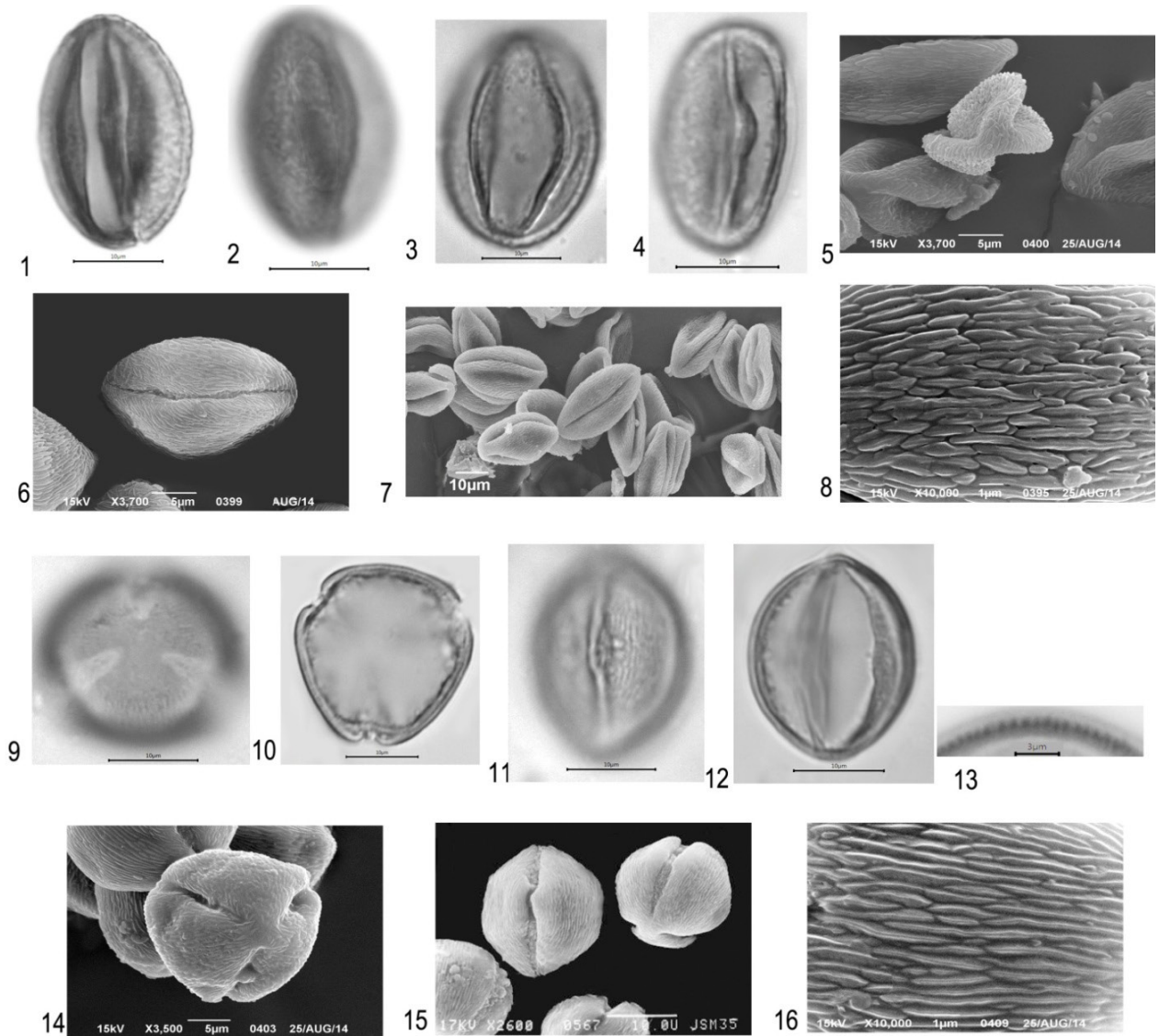
(табл. 1, фототабл. VI, VII)

Usually thorny shrubs. The number of species in Armenia – 4.

Pollen grains are 3-zonocolp-orate (oroidate), oblong (narrowly or widely) or almost spheroidal (*L. depressum* Stocks, *L. ruthenicum* Murray), in polar view the outline is 3-lobed or rounded-triangular; polar axis 17,9-25,5 μm , equatorial diameter 12,3-19,5 μm . Colpi are long, from wide to narrow, sometimes with almost parallel edges, the ends are slightly narrowed, ornamentation of colpi membrane is granulate-verrucate (SEM); apocolpium diameter 2,9-5,6 μm , mesocolpium width 12,0-18,5 μm ; in pollen of *L. barbarum*, the presence of small geniculum¹ have been marked (phototable VI, 14, 15). Ora are small, sometimes barely beyond the limits of the colpi, roundish or lanceolate. Exine 1,3-2,2 μm , columellae short, thin, thickened at the base or at the ends (*L. barbarum*). Exine ornamentation is striate, reticulate-striate (LM); exine ornamentation is perforate-striate, striae short (*L. anatolicum*, *L. barbarum*), perforate (or finely reticulate)-striate, striae short (*L. depressum*) or regularly finely reticulate, densely perforate to the poles, along the colpi edges exine ornamentation is psilate (*L. ruthenicum*) (SEM).

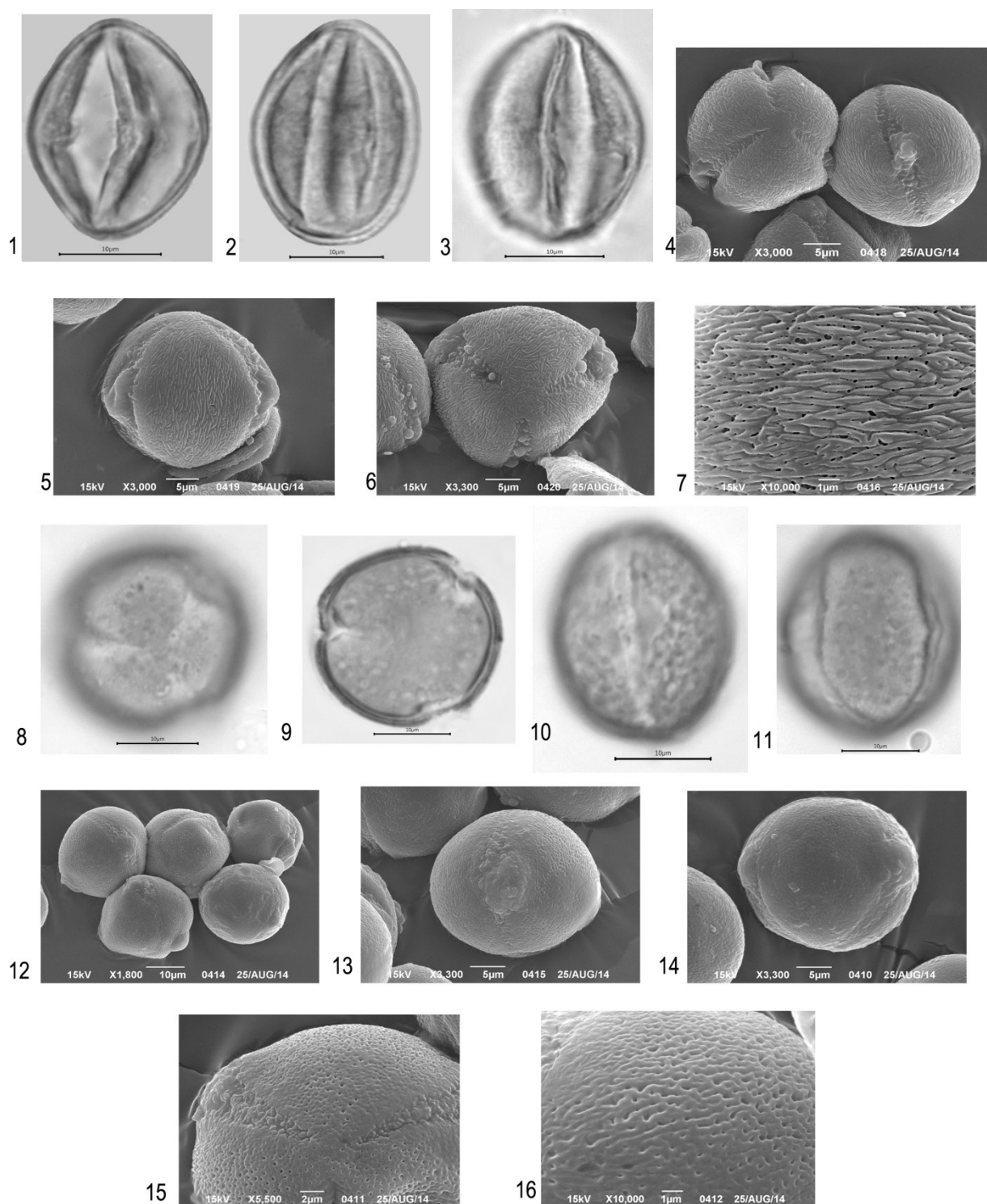
¹ **Geniculum** (*genicula* – pl.) – a bulge in the equatorial exine of the colpus, as a rule, associated with a separation of ectexine from endexine and the breaking of the latter (Potonie 1934; Punt et al. 2007).

For *L. anatolicum* a significant amount (up to 50-60%) of sterile pollen grains was noted.



Phototable VI. Pollen grains of some species of the genus *Lycium* L.

1-8 – *L. anatolicum* A. Baytop et R. Mill. (1-4 – pollen grains from equatorial view (LM), 5 – pollen grain from polar view, 6 – pollen grain from equatorial view (colpus), 7 – overall view, 8 – exine ornamentation (SEM)); 9-16 – *L. barbarum* L. (9-10 – pollen grains from polar view, 11-12 – pollen grains from equatorial view, 13 – exine (LM), 14 – pollen grain from polar view, 15 – pollen grains from equatorial (colpus) and semipolar view, 16 – exine ornamentation (SEM))
(scale bar: 1-3, 9-12 – 10 μ m, 13 – 3 μ m)



Phototable VII. Pollen grains of some species of the genus *Lycium* L.

1-7 – *L. turcomanicum* Turcz. Stocks (syn. *L. depressum* Stocks) (1-3 – pollen grains from equatorial view (LM), 4 – pollen grains from polar and equatorial view, 5 – pollen grain from equatorial view (mesocolpium), 6 – pollen grains from polar view, 7 – exine ornamentation (SEM)); 8-16 – *L. ruthenicum* Murray (8-9 – pollen grains from polar view, 10-11 – pollen grains from equatorial view (10 – colpus, 11 – mesocolpium) (LM), 12 – overall view, 13-14 – pollen grains from equatorial view (13 – colpus, 14 – mesocolpium), 15 – pollen grains from polar view (colpi ornamentation), 16 – exine ornamentation (SEM))

(scale bar: 1-3, 8-11 – 10 μ m)

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

Species	Pollen grain size (P x E) (μm)	Colpus		Exine ornamentation	
		apocolpium diameter (μm)	mesocolpium width (μm)	LM	SEM
<i>L. anatolicum</i> A. Baytop et R. Mill.	22,4-23,0 x 12,3-15,5	3,5-5,6	12,0-13,5	reticulate- striate	perforate-striate, striae short
<i>L. barbarum</i> L.	21,0-23,5 x 17,4-19,5	2,9-4,8	12,5-15,9	striate	– // –
<i>L. depressum</i> Stocks	17,9-22,5 x 15,4-18,5, or 17,4-18,2 in diam.	3,2-5,5	16,8-18,5	– // –	perforate (or finely reticulate)-striate, striae short
<i>L. ruthenicum</i> Murray	23,6-25,5 x 19,7-22,0, or 18,2-19,1 in diam.	3,6-3,8	12,6-16,8	finely reticulate	regularly finely reticulate, densely perforate to the poles

STAPHYLEACEAE (DC.) Lindl.

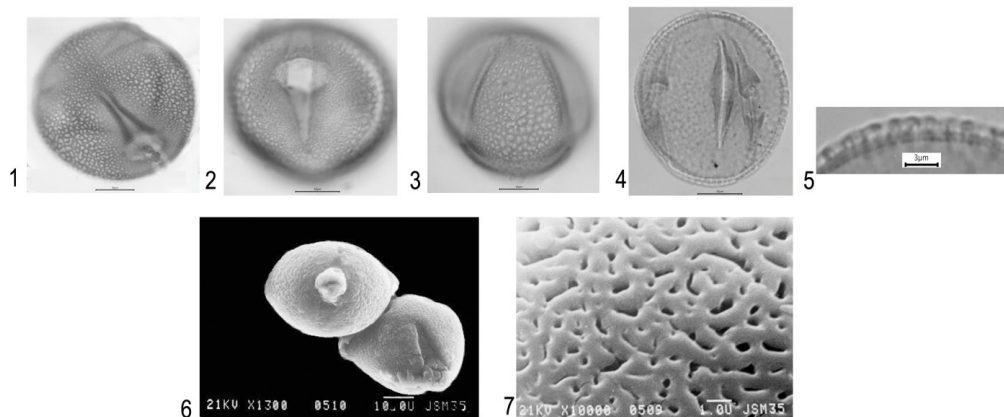
The total number of genera in Armenia – 1. The number of genera of trees and/or shrubs in Armenia – 1

***Staphylea* L.**

Erdtman, 1952; Avetisyan, Mekhakyán, 1973; Kuprianova, Alyoshina, 1978; Dickison, 1987; Harris et al., 2016

S. pinnata L. (phototable VIII). Pollen grains are 3(4)-zonocolp-orate, from broadly ellipsoidal to oblate-

spheroidal, in polar view the outline is 3(4)-angular; polar axis 27,5-35,9 μm , equatorial diameter is 34,5-37,0 μm . Colpi are long, wide, the ends are slightly pointed; a thickening of the exine layer is noted along the edges of the colpi, and in the corners of the intersection of the colpi and ora; apocolpium diameter 7,5-9,1 μm , mesocolpium width 22,5-25,1 μm . Os are large, elliptical, the ends are mostly diffuse; ora length 9,2-12,5 μm , ora width 5,0-8,3 μm . Exine 1,6-1,8 μm , columellae with large, rounded heads. Exine ornamentation is irregularly-reticulate, towards the apocolpiums is foveate (LM); exine ornamentation is irregularly reticulate-foveate, lumina muri are thick, muri vary in size (SEM).

Phototable VIII. Pollen grains of *Staphylea pinnata* L.

1 – pollen grain from semipolar view, 2-3 – pollen grain from semiequatorial view (2 – aperture, 3 – mesocolpium), 4 – pollen grain from equatorial view (exine thickening around the colpi), 5 – exine (LM), 6 – overall view, 7 – exine ornamentation (SEM) (scale bar: 1-4 – 10 μm , 5 – 3 μm)

TAMARICACEAE Link

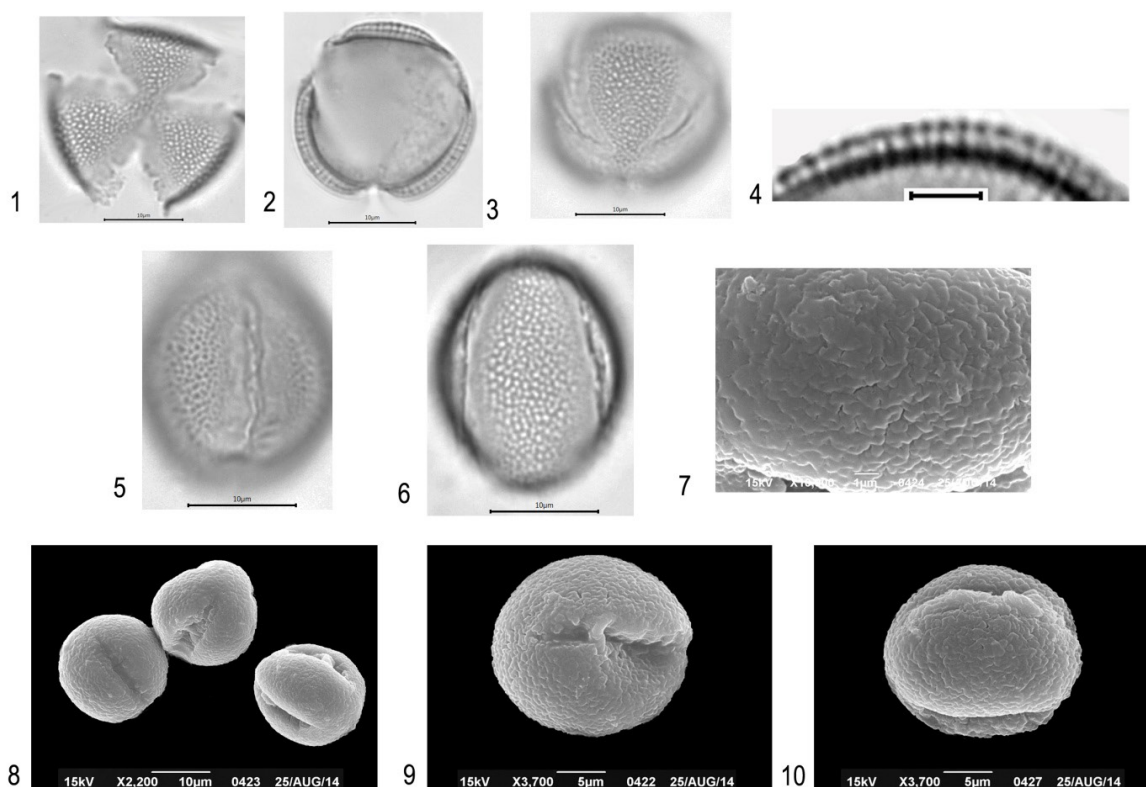
The total number of genera in Armenia – 3. The number of genera of trees and/or shrubs in Armenia – 2

***Myricaria* Desv.**

Erdtman, 1952; Erdtman et al., 1961; Avetisyan, Manukyan, 1966; Kuprianova, Alyoshina, 1978; Qaiser, Perveen, 2004

Shrub up to 2 m tall. The number of species in Armenia – 1.

***M. alopecuroides* Schrenk (syn. *M. germanica* C. A. Mey.)** (phototable IX). Pollen grains are 3-zonocolpate, broadly ellipsoidal, in polar view the outline is roundish; polar axis 18,7-22,0 μm , equatorial diameter 14,5-16,5 μm . Colpi are long, not wide, or narrow, with uneven edges and pointed ends, apocolpium diameter 3,5-4,4 μm , mesocolpium width 10,0-12,5 μm . Exine 1,2-1,3 μm , columellae thin, regularly spaced, with rounded heads. Exine ornamentation is regularly reticulate (LM); exine ornamentation is perforate-plicate (SEM).



Phototable IX. Pollen grains of *Myricaria alopecuroides* Schrenk

1 – pollen grain from polar view, 2-3 – pollen grain from semipolar view, 4 – exine, 5-6 – pollen grain from equatorial view (5 – colpus, 6 – mesocolpium and exine ornamentation) (LM), 7 – exine ornamentation, 8 – overall view, 9-10 – pollen grain from equatorial view (9 – colpus, 10 – mesocolpium) (SEM)

(scale bar: 1-3, 5, 6 – 10 μm , 4 – 3 μm)

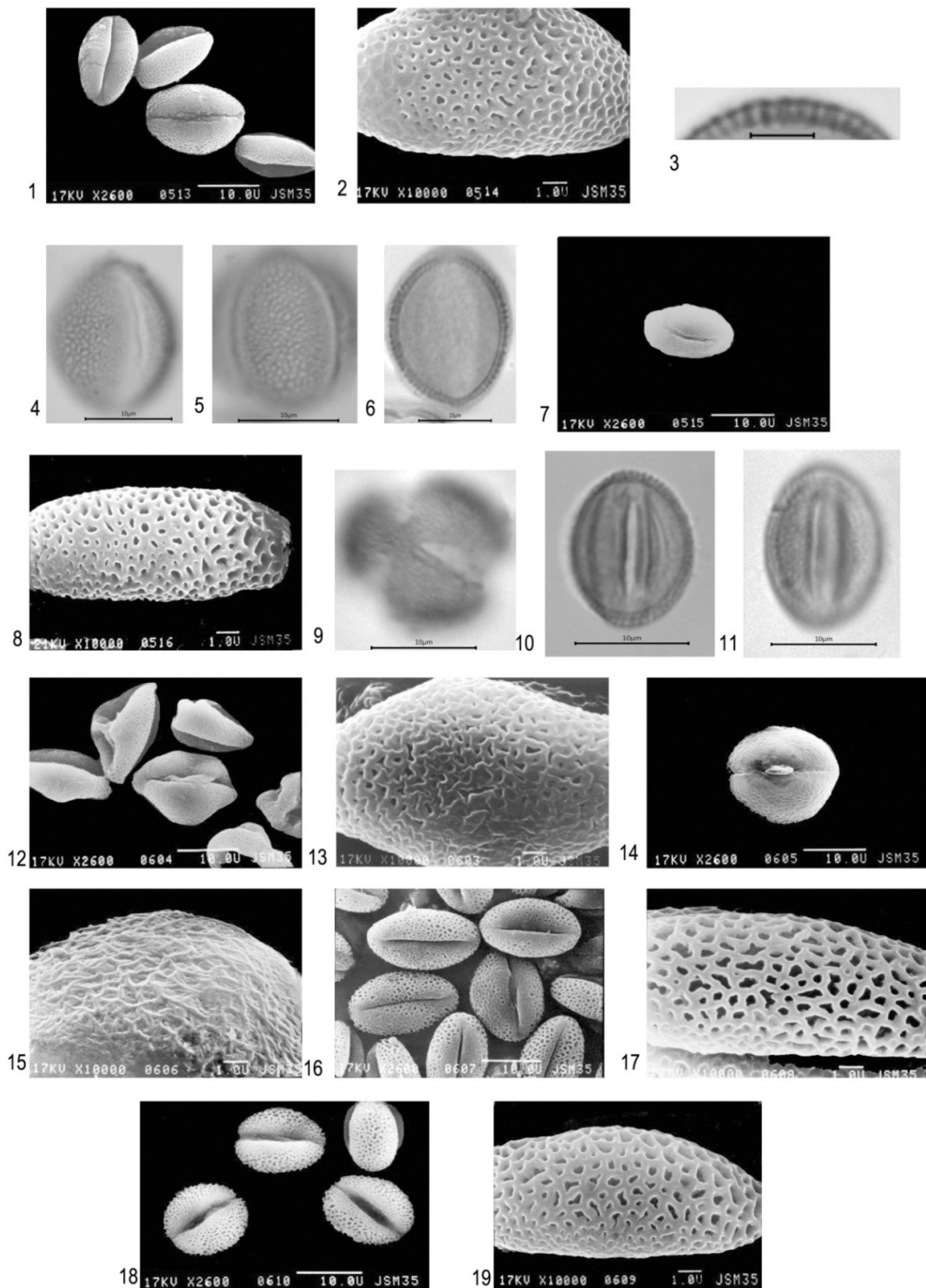
***Tamarix* L.**

Erdtman, 1952; Nair, 1962; Avetisyan, Manukyan, 1966; Baum et al., 1970; Kuprianova, Alyoshina, 1978; Trigo & Fernández, 1994; Jones et al., 1995; Sekina et al., 1995; Beug, 2004; Qaiser, Perveen, 2004, Elkordy, Faried, 2017; Kai-Qing Lu et al., 2018

(plate 4, phototable X)

Small trees or shrubs. The number of species in Armenia – 9.

Pollen grains are 3-zonocolpate, broadly ellipsoidal, in polar view the outline is 3-lobed; polar axis 12,4-20,1 μm , equatorial diameter 10,2-17,0 μm . Colpi are long, narrow, sometimes almost slit-like, with uneven edges, pointed at the ends; apocolpium diameter 1,9-3,8 μm , mesocolpium width 5,3-10,1 μm . Exine 1,2-1,4 μm , columellae are thin, regularly spaced, with rounded heads. Exine ornamentation is finely reticulate (LM); exine ornamentation is represented by variations of reticulate ones (plate 4) (SEM).



Phototable X. Pollen grains of some species of the genus *Tamarix* L.

1-2 – *T. florida* Bunge (1 – overall view, 2 – exine ornamentation (SEM)); 3-8 – *T. hohenackeri* Bunge (3 – exine, 4-6 – pollen grain from equatorial view (4 – colpus, 5 – mesocolpium) (LM), 7 – pollen grain from polar view, 8 – exine ornamentation (SEM)); 9-13 – *T. kotschyi* Bunge (9 – pollen grain from polar view, 10-11 – pollen grain from equatorial view (LM), 12 – overall view, 13 – exine ornamentation (SEM)); 14-15 – *T. octandra* Bunge (14 – pollen grain from equatorial view, 15 – exine ornamentation (SEM)); 16-17 – *T. ramosissima* Ledeb. (16 – pollen grains from equatorial view, 15 – exine ornamentation (SEM)); 18-19 – *T. smyrnensis* Bunge (18 – overall view, 19 – exine ornamentation (SEM))
(scale bar: 3 – 3 μm , 4-6, 9-11 – 10 μm)

Plate 4. Palynomorphological characteristics of some species of the genus *Tamarix* L.

Species	Pollen grain size (P x E) (µm)	Colpus		Exine ornamentation	
		apocolpium diameter (µm)	mesocolpium width (µm)	LM	SEM
<i>T. florida</i> Bunge	14,5-18,5 x 10,2-13,4	2,3-3,1	5,3-8,7	finely reticulate	reticulate-foveate
<i>T. hohenackeri</i> Bunge	14,5-20,0 x 12,5-16,9	2,9-3,8	7,5-8,9	– // –	– // –
<i>T. kotschyi</i> Bunge	15,8-16,7 x 10,5-15,8	2,5-3,2	6,2-7,9	– // –	irregularly-reticulate, lumina muri flexuous
<i>T. litwinowii</i> Gorschk.	17,0-18,0 x 14,2-15,5	3,1-3,7	5,9-7,5	– // –	–
<i>T. meyeri</i> Boiss.	18,5-20,0 x 12,7-14,5	2,7-3,8	7,1-8,3	– // –	–
<i>T. octandra</i> Bunge	16,8-18,0 x 16,5-17,0	2,5-3,5	8,7-10,1	– // –	plicate-reticulate
<i>T. ramosissima</i> Ledeb.	17,9-20,1 x 11,5-14,7	3,2-3,5	6,5-8,9	– // –	irregularly-reticulate, sometimes psilate around the colpi
<i>T. smyrnensis</i> Bunge	12,4-14,5 x 11,7-12,9	1,9-2,5	7,5-8,9	– // –	irregularly-reticulate, finely reticulate around the colpi

ACKNOWLEDGEMENTS

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

REFERENCES

- Acevedo-Rodriguez P., P. C. Van Welzen, F. Adema, R. W. J. M. Van Der Ham. 2011. *Sapindaceae* // Kubitzki K. (ed.) Flowering Plants. Eudicots. Sapindales, Cucurbitales, Myrtaceae. P. 357-407.
- Al-Quran S. 2004. Pollen morphology of *Solanaceae* in Jordan // Pak. J. Bot., 7, 9: 1586-1593.
- Avetisyan E. M., Manukyan L. K., 1966. Description of the pollen of *Salicaceae* // Flora of Armenia, 5. Yerevan, 384 pp. (in Russ.) (Аветисян Е. М., Манукян Л. К. 1966. Описание пыльцевых зерен сем. *Salicaceae* // Флора Армении, 5. Ереван. 384 с.)
- Avetisyan E. M., Mekhakyun A. K., 1973. Description of the pollen of *Aceraceae*, *Anacardiaceae*, *Araliaceae*, *Celastraceae*, *Cornaceae*, *Ebenaceae*, *Elaeagnaceae*, *Ericaceae*, *Malvaceae*, *Nitrariaceae*, *Punicaceae*, *Rhamnaceae*, *Staphyleaceae*, *Thymeleaceae*, *Tiliaceae*, *Vitaceae*, *Zygophyllaceae* // Flora of Armenia, 6. Yerevan, 485 pp. (in Russ.) (Аветисян Е. М., Мехакян А. К. 1973. Описание пыльцевых зерен сем. *Aceraceae*, *Anacardiaceae*, *Araliaceae*, *Celastraceae*, *Cornaceae*, *Ebenaceae*, *Elaeagnaceae*, *Ericaceae*, *Malvaceae*, *Nitrariaceae*, *Punicaceae*, *Rhamnaceae*, *Staphyleaceae*, *Thymeleaceae*, *Tiliaceae*, *Vitaceae*, *Zygophyllaceae* // Флора Армении, 6. Ереван. 485 с.)
- Avetisyan E. M., Mekhakyun A. K., 1987. Description of the pollen of *Solanaceae* // Flora of Armenia, 8. Yerevan, 419 p. (in Russ.) (Аветисян Е. М., Мехакян А. К. 1987. Описание пыльцевых зерен сем. *Solanaceae* // Флора Армении, 8. Ереван. 419 с.)
- Babayi F., Pakravan M., Maassoumi A. A. & Tavasoli A.

2012. Palynological study of *Salix* L. (*Salicaceae*) in Iran // Iran. J. Bot. 18, 1: 118-126.
- Basak R. K. 1967. The pollen grains of *Solanaceae* // Bull. Bot. Soc. Bengal, 21, 1: 52-53.
- Basset, I. J., Crompton, C. W., Parmelee, J. E. 1978. An atlas of airborne pollen grains and common fungus spores of Canada. Monogr. 18. Can. Dept. Agric., Ottawa, 321 p.
- Baum B. R., I. J. Bassett, C. W. Crompton. 1970. Pollen morphology and its relationships to taxonomy and distribution of *Tamarix*, series *Vaginantes*. Österreichische Botanische Zeitschrift, 118, No. ½: 182-188
- Bernardello L. & Lujan M. C. 1997. Pollen morphology of the tribe *Lycieae*: *Grabowskia*, *Lycium*, *Phrodus* (*Solanaceae*) // Rev. Palaeobot. Palynol., 96: 305 – 315.
- Beug, H.-J. 2004. Leitfaden der Pollenbestimmung für Mitteleuropa und angrenzende Gebiete. Verlag Friedrich Pfeil, Munich, 542 pp. (+120 plates, 12 tables).
- Bobrov A. E., Kupriyanova L. A., Litvintseva M. V., Tarasevich V.T. 1983. Ferns spores and pollen of gymnosperms and monocotyledons of the flora of the European part of the USSR. L., "Science". 208 с. (in Russ.) (Бобров А. Е., Куприянова Л. А., Литвинцева М. В., Тарасевич В. Т. 1983. Споры папоротникообразных и пыльца голосеменных и однодольных растений флоры европейской части СССР. Л., "Наука". 208 с.).
- Cabrera, M. M. & Cuadrado G. Morfología Polínica de las *Solanaceae* del Nordeste Argentino, Subfamilia *Solanoideae* Tribu: *Solaneae*, *Datureae*, *Jaboroseae* y *Lycieae* 2007. http://www.culturaapicola.com.ar/apuntes/floraapicola/81_morfologia_polinica_solanaceas.
- Cao Li-min, Xia Nian-He, Cao Ming, Li Xiang-Long. 2016. Pollen morphology and its systematic significance in *Sapindaceae* from China // Plant Science Journal, 34, 6: 821-833.
- Chen S.-C., X.-P. Zhang, S.-F. Ni, C.-X. Fu, K. M. Cameron. 2006. The systematic value of pollen morphology in *Smilacaceae* // Pl. Syst. Evol., 259: 19-37.
- Dickson W. C. 1987. A palynological study of the *Staphyleaceae* // Grana, 26, 1: 11-24.
- Dzyuba O. F. 2005. Atlas of pollen grains most common in the air basin of Eastern Europe. Nycomed. Moscow. 68 p. (in Russ.) (Дзюба О. Ф. 2005. Атлас пыльцевых зерен наиболее часто встречающихся в воздушном бассейне Восточной Европы. Nycomed. Москва. 68 с.)
- El-Ghazaly G. A. 1992. Pollen flora of Qatar. Univ. of Qatar. 429 p.
- Elkordy A., Faried A. 2017. Pollen morphology and numerical analysis of *Tamarix* L. (*Tamaricaceae*) in Egypt and its systematic implication // Bangladesh J. Plant Taxon., 24, 1: 91–105.
- Erdtman G. Pollen morphology and plant taxonomy. Angiosperms. Stockholm, 1952. 539 p.
- Erdtman G. 1954. An introduction to pollen analysis. Waltham, Mass., USA. 239 p.
- Erdtman G., Berglung B., Praglowski J. 1961. An introduction to a Scandinavian Pollen Flora. Grana Palynol., 2 (3): 3-92.
- Ferruffino A. L. & Gymeze-Laurito J. 2004. Estudio morfológico de *Smilax* L. *Smilacaceae* en Costa Rica, con implicaciones sistematicas // Lankesteriana, 4, 1: 5-36.
- Furness C. A., P. J. Rudall. 1999. Inaperturate pollen in monocotyledons // Int. J. Plant Sci. 160, 2: 395-414.
- Furness C. A., T. Gregory, and P. J. Rudall. 2015. Pollen structure and diversity in Liliales. Int. J. Plant Sci. 176, 8: 697-723.
- Gajewski K., M. Vetter, N. Paquette. 2017. Pollen Atlas of Arctic and Boreal Canada. AASP Foundation. 241 p.
- Harris A. J., Ping-Ting Chen, Xin-Wei Xu, Jian-Qiang Zhang, Xue Yang, Jun Wen. 2016. A molecular phylogeny of *Staphyleaceae*: Implications for generic delimitation and classical biogeographic disjunctions in the family // Journal of Systematics and Evolution, 55, 2: 1-18.
- Hayrapetyan A. M. 2008a. Features of the exine ornamentation of pollen grains in the family *Solanaceae* Juss. The simple types of ornamentation // Electronic Journal of Natural Sciences of NAN RA. Botany, 2, 11: 46-50.
- Hayrapetyan A. M. 2008b. Features of the exine ornamentation of pollen grains in the family *Solanaceae* Juss. II. The complex types of ornamentation // Biological journal of Armenia, LX, 3: 29-37 (in Russ.) (Айрапетян А. М. 2008. Особенности скульптуры экзины пыльцевых зерен в семействе *Solanaceae* Juss. II. Сложные типы скульптуры // Биолог. журн. Армении, LX, 3: 29-37).
- Hayrapetyan A. M. 2008c. Overall characteristic and comparative analysis of the exine ornamentation of pollen grains within the limits of the order *Solanales* // Biological journal of Armenia, LX, 4: 6-15 (in Russ.) (Айрапетян А. М. 2008. Общая характеристика и сравнительный анализ скульптурных типов пыльцы в пределах порядка *Solanales* // Биолог. журн. Армении, LX, 4: 6-15).
- Hayrapetyan A. M. 2010. Palynology of the

- superorder *Solananae* within orders *Solanales* and *Convolvulales* // Abstract of the Thesis of Doctor of Sciences (Biology) Yerevan. 47 p. (in Russ.) (Айрапетян А. М. 2010. Палинология надпорядка *Solananae* в пределах порядков *Solanales* и *Convolvulales* // Автореф. дисс. ... докт. биол. наук. Ереван. 47 с.)
- Jonas Fr. 1952. Atlas zur Bestimmung ezenter und fissuler Pollen und Spores // Fed. Rep. B. 133. 60 p. (+ 57 tables).
- 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. No. 30.76 pp. + 104 plates.
- Kai-Qing Lu, Gan Xie, Min Li, Jin-Feng Li, Anjali Trivedi, D. K. Ferguson, Yi-Feng Yao, Yu-Fei Wang. 2018. Dataset of pollen morphological traits of 56 dominant species among desert vegetation in the eastern arid central Asia // Data in Brief, 18: 1022–1046.
- Karpovich I. V., Drebezgina Ye. S., Elovikova E. A., Legotkina G. I., Zubova E. N., Kuzyaev R. Z., Khismatullin R. G. 2015. Pollen atlas. The Ural worker: Yekaterinburg. 318 p. (+ 288 plates) (in Russ.) (Карпович И. В., Дребезгина Е. С., Еловикина 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.)
- Kezina T. V. Morphology of some *Salicaceae* pollen. Palynology in the USSR: 61-64 [in Russ]. (Кезина Т. В. 1988. Морфология пыльцы некоторых представителей Ивовых. Палинология в СССР. Изд. "Наука". Новосибирск. С 61-64).
- Kodela P. G. 2006. Pollen morphology of some rainforest taxa occurring in the Illawarra region of New South Wales, Australia // Telopea 11, 3: 346–389.
- Kupriyanova L. A. 1965. Palynology of Amentiferae. Moscow, Leningrad: Nauka. 214 p. (in Russ.) (Куприянова Л. А. 1965. Палинология сережкоцветных (Amentiferae). "Наука", М.-Л. 2014 с.)
- Kupriyanova L. A., Alyoshina L. A. 1978. Pollen and spores of plants from the flora of European part of the USSR. 2. *Lamiaceae-Zygophyllaceae*. Akademia Nauk SSSR, Komarov Bot Inst., Leningrad. 184 pp. (in Russ.) (Куприянова Л. А., Алешина Л. А. 1978. Пыльца двудольных растений флоры Европейской части СССР. Ленинград. «Наука», 183 с.)
- Meyer F. G. 1976. A revision of the genus *Koelreuteria* (*Sapindaceae*) // Arnold Arboretum, 57, 2: 129-166.
- Muller, J., Leenhouts, P. W. 1976. A general survey of pollen types in *Sapindaceae* in relation to taxonomy // Ferguson, I. K., Muller, J. (eds.) The evolutionary significance of the exine. Linnean Soc. Symp. Ser. 1, pp. 407–445. London: Academic Press.
- Murry L. E. & Eshbaugh W. E. 1971. A palynological study of the *Solaninae* (*Solanaceae*) // Grana, 11, 2: P. 65-78.
- Myachina A. I., Kazachikhina L. L., Mamontova I. B., Kalinina V. S. 1971. Atlas of spores and pollen of some modern plants of the Far East. Academy of Sciences of the USSR, Khabarovsk. 85 p. (+ 53 tab.) (in Russ.) (Мячина А. И., Казачихина Л. Л., Мамонтова И. Б., Калинина В. С. 1971. Атлас спор и пыльцы некоторых современных растений Дальнего Востока. АН СССР, Хабаровск. 85 с. (+ 53 табл.)).
- Nair, P. K. K. 1962. Pollen grains of Indian plants. II // Bull. Gard. Lucknow, 60: 6-9.
- Perveen A., Qaiser M. 2007. Pollen morphology of family *Solanaceae* from Pakistan // Pak. J. Bot., 39, 7: 2243-2256.
- Petruk A. A. 2009. Morphology of pollen grains of representatives of the subgenus *Chamaetia* of the genus *Salix* (*Salicaceae*) according to electron microscopy // Flora of Asian Russia (Rastitel'nyy mir Aziatskoy Rossii), 1, 3: 53-59 (in Russ.) (Петрук А. А. 2009. Морфология пыльцевых зерен представителей подрода *Chamaetia* рода *Salix* (*Salicaceae*) по данным электронной микроскопии // Растительный мир Азиатской России, 1, 3: 53-59)).
- Praglowksi J. R. 1962. Notes on the pollen morphology of Swedish trees and shrubs // Grana Palynol., 3, 2: 45-65.
- Punt W. & Monna-Brands M. 1980. *Solanaceae* // W. Punt, G. C. S. Clarke. The Northwest European pollen flora, II, 8- 20: 1-30.
- Qaiser M., Perveen A. 2004. Pollen flora of Pakistan-XXXVII. *Tamaricaceae* // Pak. J. Bot., 36, 1: 1-18.
- Radzevich N. D. 1950. Pollen morphology of the family *Betulaceae, Juglandaceae, Salicaceae* // In: Pollen analysis (ed. A. N. Krishtofovich). Moscow. 570 p. (Радзевич Н. Д. 1950. Морфология пыльцы сем. *Betulaceae, Juglandaceae, Salicaceae* // В кн.: Пыльцевой анализ (под ред. А. Н. Криштофовича). Москва. 570 с.)
- Richard, P. 1970. Atlas pollinique des arbres et de quelques arbustes indigenes du Quebec. III. Angiospermes (*Salicacées, Myricacées, Juglandacées, Corylacées, Fagacées, Ulmacées*). Naturaliste canadienne, 97: 97–161.
- Rowley J. R., Erdtman G. 1967. Sporoderm in *Populus*

- and *Salix* // Grana Palynol., 7, 2-3: 518-567.
- Ryabkova L. S. 1987. Palynography of the flora of the Tajik SSR (*Cyperaceae-Portulacaceae*). Science. Leningrad. 110p. (+ 80 phototables). (in Russ.) (Рябкова Л.С. 1987. Палинография флоры Таджикской ССР (Осоковые-Портулаковые). Наука. Ленинград. 110 с. (+ 80 фототабл.))
- Sekina, M. Аyyad, P. D. Moore. 1995. Morphological studies of the pollen grains of the semi-arid region of Egypt // Flora, 190: 115-133.
- Surova T. G. 1975. Electron microscope investigation of plants pollen and spores. Nauka. Moscow. 87p. (in Russ.) (Сурова Т. Г. 1975. Электронно-микроскопическое исследование пыльцы и спор растений. Москва. "Наука". 87 с.)
- Tokarev P. I. 2004. Palynology of woody plants growing on the territory of Russia. Synopsis of thesis. Diss... Doct. Biol. Sciences. Moscow. 55 p. (in Russ.) (Токарев П. И. 2004. Палинология древесных растений, произрастающих на территории России. Автореф. дисс. ... докт. биол. наук. Москва. 55 с.)
- Trigo M. M., I. Fernández. 1994. Contribución al estudio polínico de especies ornamentales con interés alergógeno cultivadas en Málaga: Dicotiledóneas. Acta Bot. Malacitana, 19: 145-168.
- Valdés B., Díez M. J., Fernandes I. 1987. Atlas polinico de Andalucía Occidental. Universidad de Sevilla. 451p.
- Wang J.- Q. 1985. Studies on the pollen morphology of family *Salicaceae* in Gansu China // Acta Botanica Sinica 27, 6: 594-598.
- Wang, Y.-F. and S.-H. Chen. 2002. Pollen flora of Yuenyang Lake Nature Preserve, Taiwan (IV) // Taiwanian 47: 129-158
- Willard D. A., C. E. Bernhardt, L. Weimer, S. R. Cooper, D. Gamez, J. Jensen. 2004. Atlas of pollen and spores of the Florida Everglades // Palynology, 28: 175-227.

Institute of Botany after A. Takhtajyan NAS RA
0040, Yerevan, Acharyan, 1
alla.hayrapetyan.63@gmail.com