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The Clypeate pollen grains of Turkish *Iris* L. (*Iridaceae*): Subgenus *Scorpiris* Sach

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Abstract : The clypeate pollen grains of some species of Turkish *Iris* L. (*Iridaceae*) taxa belonging to the subgenus *Scorpiris* Spach have been investigated. Attention is given to characteristics of exine sculpturing and the exine shields using light microscopy and scanning electron microscopy. The pollen grains of the *Scorpiris* are shown to be uniform, especially with regard to pollen shape and exine sculpturing. However, a trend towards greater pollen size accompanied by higher exine shield number is noted from the less specialised taxa to the more specialised taxa. It is also considered that the clypeate pollen type is unique to subgenus *Scorpiris* among Turkish irises.

Key Words: Clypeate pollen; *Iris*, *Iridaceae*, Flora of Turkey

Türkiye *Iris* L. (*Iridaceae*) cinsinin *Scorpiris* Sach altcinsinde klipet polenler

Özet : Türkiye'de bulunan *Iris* L. (*Iridaceae*) cinsine ait *Scorpiris* Spach alt cinsi üyelerinin bazı örneklerinin klipet polenleri ışık ve taramalı elektron mikroskopları kullanılarak, bilhassa ekzin süslenmesi ve ekzin kütlelerinin özellikleri dikkate alınarak incelenmiştir. Bu altcins üyelerinin polenlerinin, özellikle polen şekli ve ekzin süslenmesi açısından birbirine benzediği gösterilmiştir. Bununla birlikte, ilkel taksonlardan ileri kabul edilen taksonlara doğru polen boyutunun ve ekzin kütle sayısının arttığı belirlenmiştir. Klipet polenlerin Türkiye'de bulunan *Iris* türleri içinde sadece *Scorpiris* altcinsi üyelerine özgü olduğuna değinilmiştir.

Anahtar Sözcükler: Klipet polen, *Iris*, *Iridaceae*, Türkiye Florası

Introduction

Taxonomic studies of the genus *Iris* L. (*Iridaceae*) in Turkey have been carried out by Güner and Peşmen (1980) and Mathew (1984, 1989). According to Mathew, in the Flora of Turkey the genus consists of about 44 taxa, subdivided into four subgenera: *Limniris* (Tausch) Spach, *Iris* L., *Hermodactyloides* Spach and *Scorpiris* Spach in that order.

A pollen morphological study of almost all Turkish *Iris* species with reference to evolutionary trends was carried out by Pınar and Oybak Dönmez (2000), and general comments about the morphology of clypeate pollen grains in the subgenus *Scorpiris* were presented. We have undertaken the present study to focus in more detail on the clypeate pollen type, particularly in relation to the characteristics of exine sculpturing and exine shields.

Materials and Methods

Pollen samples were taken from herbarium specimens at Hacettepe University, Faculty of Science (HUB), with the exception of one specimen from the herbarium of Ankara University, Faculty of Pharmacy (AEF). Details of all the species and specimens examined are given at the end of this section.

Pollen for light microscopy (LM) was prepared using the method described by Wodehouse (1935). Measurements of pollen grains were taken using a Nikon SE microscope and are based on a sample size of 50 or more grains for pollen diameter (PD) and of about 10 for other characteristics (Table 1). The LM micrographs were taken with a Centon camera connected to a James Swift microscope.

Table 1. Pollen morphological features of the subgenus *Scorpiris*. Abbreviation: Pollen diameter (PD) values: M-mean, St-standart, V-variation, exine shield shape: c-circular, i-irregular, p-polygonal, sc-semi-circular.

TAXA	SPECIMENS	PD			Lumina µm	Muri µm	Exine µm	Intine µm	Exine Shields		
		M µm	St	V µm					Groove width µm	Number	Shape
<i>I. aucheri</i>	B9 Siirt: AG 1626	109	± 2.5	95-125	3-15	1-1.5	3	1	13 (8-23)	2-6	i
	C8 Diyarbakır: EOD 91-AAD	119	± 2.3	105-130	6-20	1.5-2	3	1	9 (5-13)	4-9	p
	C9 Hakkari: AG 1668	133	± 0.9	117-144	4-23	1.5-2	3	1	14 (5-33)	5-9	p
<i>I. caucasica</i> ssp. <i>caucasica</i>	C9 Siirt: AG 1625	135	± 4	125-153	5-19	0.75-1	3	0.5-0.75	16 (8-30)	3-6	a
	A5 Kırıkkale: AAD 1702a	105	± 2	90-123	3-15	1-1.5	3	1	8 (5-10)	5-9	sc
<i>I. caucasica</i> ssp. <i>turcica</i>	A9 Artvin: AG 1430	101	± 1.82	88-113	8-18	1.5-2	4	0.75	9 (6-13)	6-9	sc
	A7 Gümüşhane: AG 1414	117	± 3.8	100-138	4-18	1	3	1	8 (5-13)	5-9	sc
<i>I. pseudocaucaucasica</i>	A8 Erzurum: AG 1543	104	± 2.87	93-120	5-13	1-1.25	4	0.75	9 (3-15)	5-10	p
	A9 Kars: O. Güneş 1573	113	-	90-125	2-8	1-1.5	3	1	-	7-9	sc
	B6 Kayseri: N. Çelik 1131	107	± 1.8	100-118	3-16	1	3	1	7 (3-10)	6-9	sc- c, p
	B7 Erzincan: AAD 6151	103	± 4	85-130	2-13	1.5-2	3	1	10 (5-18)	7-13	p
	B9 Ağrı: AG 1422	108	± 2.5	90-125	4-15	1-1.5	3	1	8 (5-15)	6-8	p
	B9 Bitlis: AG 1437	137	± 1.2	117-153	3-16	1-1.5	3	1	11 (5-20)	6-8	sc
	B9 Siirt: AG 1627	119	± 2.6	108-138	3-10	1-1.5	3	1	14 (8-25)	11-15	c
	C10 Hakkari: AG 1898	119	± 1.8	110-128	4-12	1-1.5	3-3.5	1	19 (8-15)	11-16	c
<i>I. stenophylla</i> ssp. <i>stenophylla</i>	B3 Isparta: BM 211	153	± 2.4	138-168	4-12	1	3	1	15 (8-25)	10-14	c
	B6 Kayseri: NÇ 1028	129	± 3	110-143	4-15	1	3-4	1	14 (8-25)	12-15	sc
	C4 Karaman: M. Karaoğlu	105	± 0.59	99-117	3-15	1-1.5	2.5-3	0.75	9 (5-13)	13-18	c
	C4 Mersin: AG 1580	147	-	128-163	3-16	1	3	1	4 (3-15)	16-20	c
<i>I. stenophylla</i> ssp. <i>allisonii</i>	C3 Antalya: M. Koyn. 9585	143	± 3.6	125-163	2-13	1-1.5	3-4	1	10 (3-18)	13-23	c
<i>I. galatica</i>	A5 Amasya: EO11-LO	132	± 1.63	108-162	5-18	2-2.5	4	0.5-0.75	12 (5-18)	9-17	sc
	A6 Tokat: AG 1481	163	-	150-178	5-24	1-1.5	3	1	5 (8-20)	10-15	sc
<i>I. persica</i>	B7 Erzincan: AG 1475	129	± 2.4	120-140	6-16	1-1.5	3-4	1	4 (3-8)	10-15	sc
	A6 Sivas: AAD 5184	144	± 3.8	123-170	3-14	1-1.5	3	1	11 (5-18)	13-26	i, sc
	B6 Kayseri: AG 8428	121	± 2.6	100-133	6-19	1-1.5	3-4	1	14 (10-23)	12-16	sc, c
	B6 Malatya: Ş. Kaplan 1001	122	± 2.6	110-150	3-13	1-1.5	3-4	1	7 (3-15)	11-13	sc
	B7 Elazığ: AG 1482	120	± 2	110-133	3-17	1-1.5	3-4	1	9 (5-13)	12-17	sc
	B7 Erzincan: AG 1641	118	-	105-128	2-20	1-1.5	3-4	1	7 (3-13)	9-15	sc
	B8 Bingöl: AG 1631	118	-	99-135	4-16	1-1.5	4	1	8 (5-13)	13-17	sc
	B/C 8/9 Siirt: AG 1602	103	± 2.75	90-123	5-23	1.75-2	3-5	0.5-0.75	16 (10-23)	7-12	sc
C5 Konya: EO13-LO	123	± 4	103-155	4-15	1-1.5	3-4	1	7 (3-13)	11-14	sc	
C6 Gaziantep: AG 1586	121	± 1.62	99-153	5-30	1.25-2	3	0.75	13 (8-18)	10-20	sc	
C7 Adıyaman: AAD 5131	156	± 2.98	143-175	5-23	1-1.25	3	0.75-1	11 (8-15)	10-15	sc	
C8 Mardin: AG 1596	147	± 2.3	133-165	5-12	1-1.5	3-4	1	13 (10-25)	10-15	sc	

A scanning electron microscope (SEM) was also used to examine the exine sculpturing in greater detail. For SEM investigations, pollen grains were first hydrated with 10% KOH for ca. 10 minutes, then rinsed with distilled water and dried before mounting and coating with gold. The SEM micrographs were taken with a Jeol CXII microscope.

In general, the terminology follows that of Punt et al. (1994). The term "clypeate" is used for pollen grains with large, isolated exinous shields, separated by grooves, following the proposal of Halbritter and Hesse (1995).

Specimens Investigated

(The taxa are in taxonomic order as given by Mathew (1984, 1989)).

I. aucheri (Baker) Sealey B9 Siirt: Şirvan, Demirkapı Köyü, 1500 m, Güner 1626, C8 Diyarbakır: 50 km from Siverek, Karacadağ, Oybak 91-Dönmez, C9 Hakkari: Kaval Köyü, 1300 m, Güner 1668, C9 Siirt: Eruh, Üzümlük (Paris) Köyü, 1100 m, Güner 1625. *I. caucasica* Hoffm. ssp. *caucasica* A5 Kırıkkale: Sulakyurt, Dönmez 1702a, A9 Artvin: Ardanuç, above Urumdere Castle,

2300 m, Güner 1430. *I. caucasica* Hoffm. ssp. *turcica* B. Mathew A7 Gümüşhane: Bağlarbaşı, Çamlıköy, 1700-2200 m, Güner 1414, A8 Erzurum: Erzurum to Ispir, 2000 m, Güner 1543, A9 Kars: Kağızman, 1550 m, Güneş 1573, B6 Kayseri: Pınarbaşı, Hınzır Da., 1750 m, Çelik 1131, B7 Erzincan: Kolçekmez Da., 1800 m, Dönmez 6151, B9 Ağrı: Eleşkirt, 2450 m, Güner 1422, B9 Bitlis: Tatvan, Nemrut Da., 2300 m, Güner 1437. *I. pseudocaucasia* Grossh. B9 Siirt: Şirvan, Demirkapı Köyü, 1050 m, Güner 1627, C10 Hakkari: Yüksekova, 1700-1800 m, Güner 1898. *I. stenophylla* Hausskn & Siehe ex Baker ssp. *stenophylla* B3 Isparta: Ş. Karaağaç, W of Zeybek Hill, 1250-1300 m, Mutlu 211, B6 Kayseri: Pınarbaşı, Hınzır Da., 1750 m, Çelik 1028, C4 Karaman: Karaman to Mut, 1200-1600 m, Karaoğlu, C4 Mersin: Silifke to Kirobası Bucağı, 1250 m, Güner 1580. *I. stenophylla* Hausskn. & Siehe ex Baker ssp. *allisonii* B. Mathew C3 Antalya: Manavgat, Koyuncu 9585-Duman, (AEF). *I. galatica* Siehe A5 Amasya: Akdağ, Kavlançayı Köyü, Oybak 11-Oybak, A6 Tokat: Gökdere, Boyalı Köyü, 900-1000 m, Güner 1481, B7 Erzincan: Cevizli (Şoha) Köyü, 1450 m, Güner 1475. *I. persica* L. A 6 Sivas: Suşehri, Gölköy, 900 m, Dönmez 5184, B6 Kayseri: Pınarbaşı to Gürün, 1740 m, Güner 8428-Karaca, B6 Malatya: Akçadağ, 1200-1700 m, Kaplan 1001, B7 Elazığ: Maden to Ergani, 1200 m, Güner 1428, B7 Erzincan: Kemaliye, Sırakonak (Pegir) Köyü, 1500-1550 m, Güner 1641, B8 Bingöl, Çukurca Köyü, 1250 m, Güner 1631, B/C 8/9 Siirt: to Sirvan, below Akyamaç Köyü, 950 m, Güner 1602, C5 Konya: Ereğli Aydos Da., 1600 m, Oybak 13-Oybak, C6 Gaziantep: Kilis to İslahiye, 550, Güner 1586, C7 Adıyaman: Sincik, Kahta, 1380 m, Dönmez 5131, Mardin to Savur, 1100 m, Güner 1596.

Results

The results of LM data on the pollen grains of the taxa and the specimens examined are summarised in the Table 1. The general pollen description, based on LM and SEM studies, is given below:

All pollen grains are clypeate and spheroidal in shape, with pollen diameter (PD) values varying from 85 to 178 µm. The exine is semitectate, eurenticulate and simplibaculate. The lumina are 2-30 µm in size and have some granulae in the bases. They are circular, elliptical or polygonal in shape. Muri width is 0.75-2 µm. Exine thickness is 2.5-4 µm and intine thickness is less than 1

µm. Exine shields are usually semi-circular, circular or polygonal, rarely irregular in shape. They range from 2 to 26 in number. The groove width is 3-33 µm. The surface of the grooves is sparsely granular (Figures 1-19).

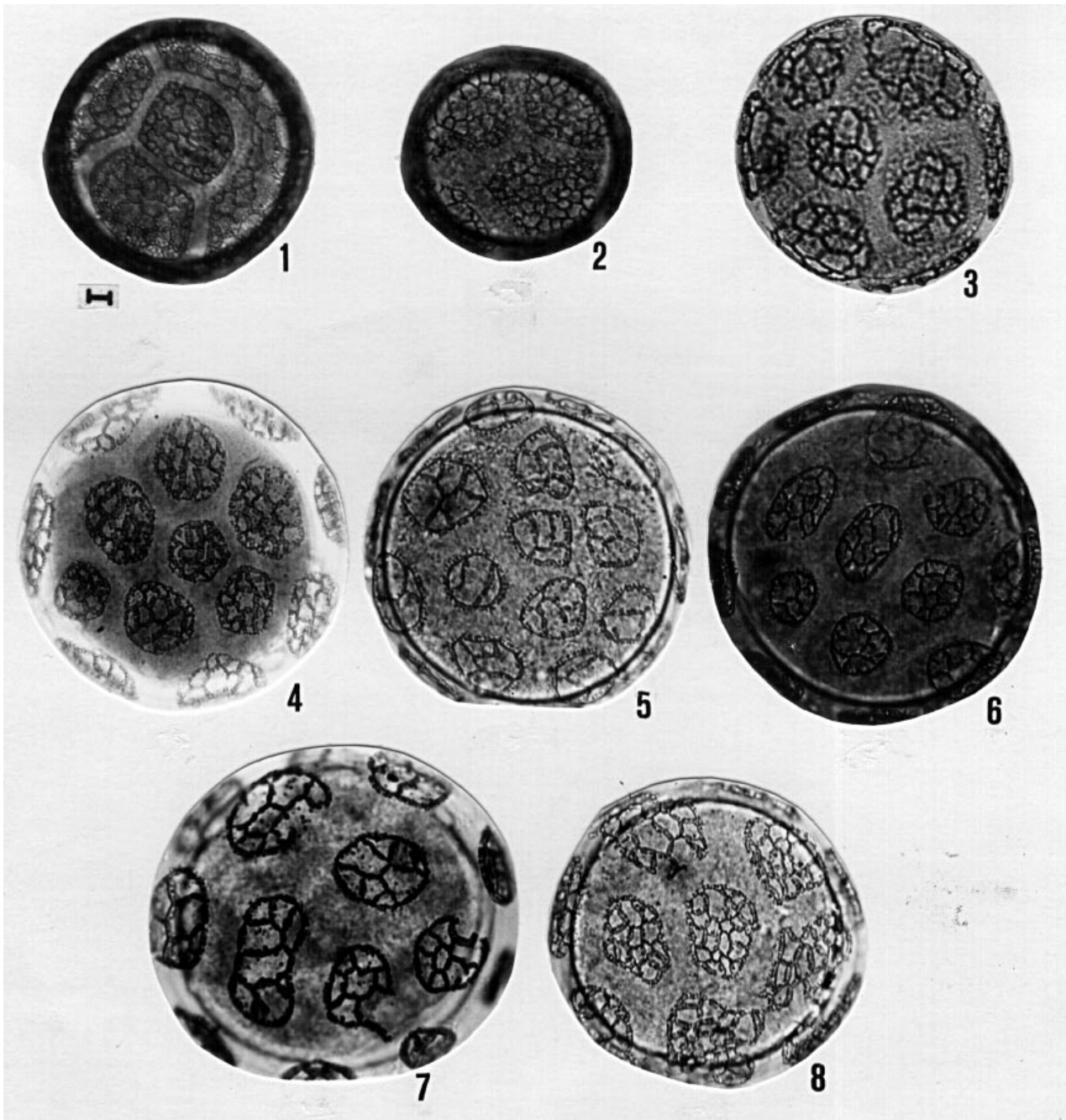
Conclusion

All *Iris* species of the subgenus *Scorpiris* show uniformity in pollen morphological characters, especially in pollen type (clypeate), pollen shape (spheroidal) and exine sculpturing (eurenticulate). However, there is a trend towards greater pollen size from the less specialised taxa to the more specialised taxa (Table 1). This situation seems to support the general idea that pollen size increases with evolution and advancement. The pollen size increase is also related to ploidy level but there are no karyological data on the subgenus *Scorpiris* yet. There is also a trend towards an increase in the number of exine shields from the less specialised taxa to the more specialised taxa. Therefore, in general, an increase in pollen diameter is associated with a greater number of exine shields in the *Iris* subgenus *Scorpiris*.

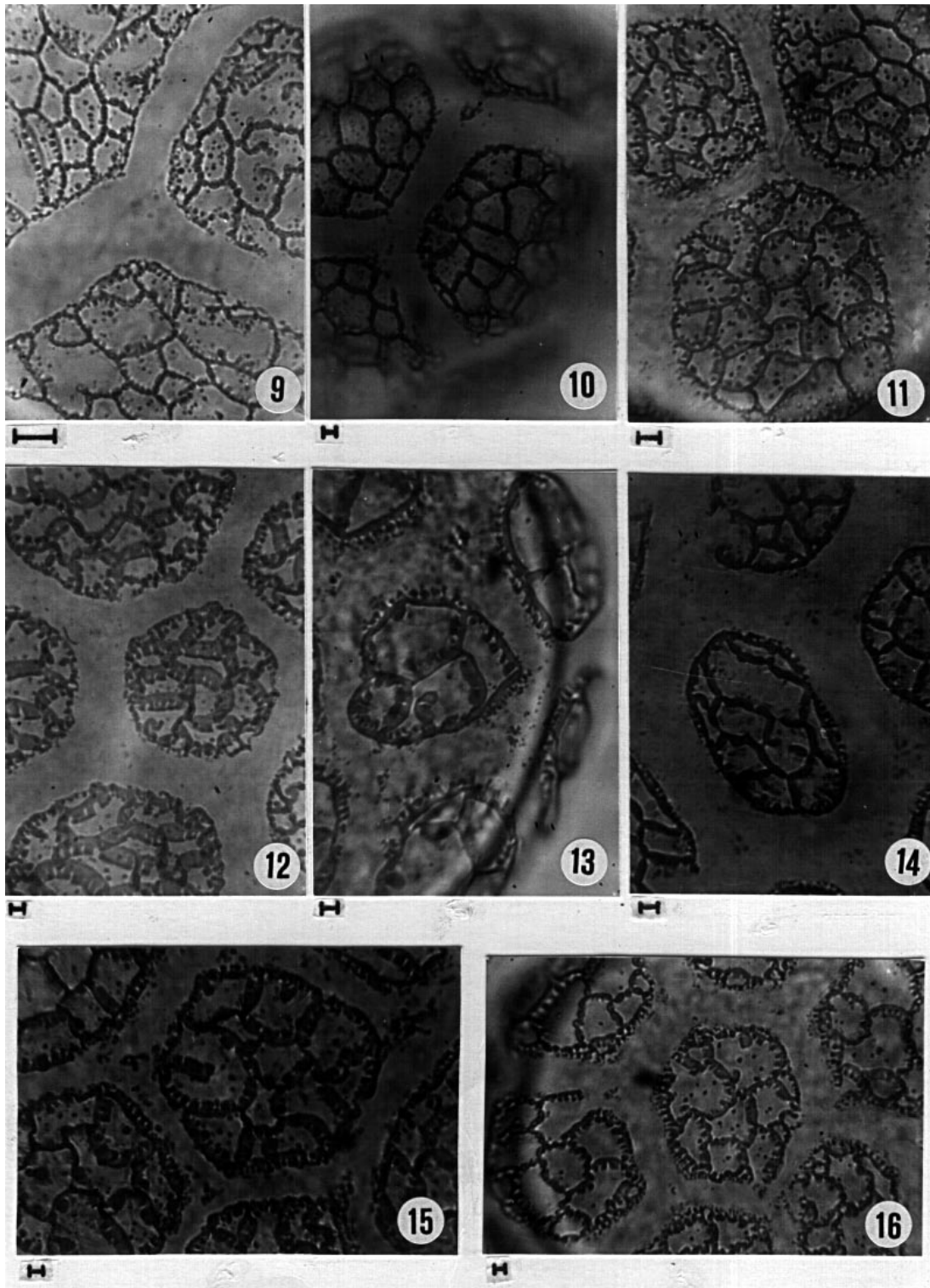
Halbritter and Hesse (1995) consider the convergent evolution of clypeate pollen grains in some taxa of distantly related angiosperm families such as *Berberidaceae* (*Mahonia*), *Bignoniaceae* (*Catalpa*), *Euphorbiaceae* (*Phyllanthus*) and *Iridaceae* (*Iris*) section *Juno* (Tratt.) Benth, synonym of the subgenus *Scorpiris*. In a more detailed study of *Iris* pollen, Pınar and Oybak Dönmez (2000) show that the clypeate pollen type is characteristic of all taxa in the subgenus *Scorpiris* while the other subgenera of the genus are characterised by either monosulcate or zonosulcate pollen. It is interesting that the pollen of the subgenus *Scorpiris* differs so remarkably from other taxa of *Iris*, yet shares a rare exine configuration with a number of systematically widespread angiosperm taxa.

Acknowledgements

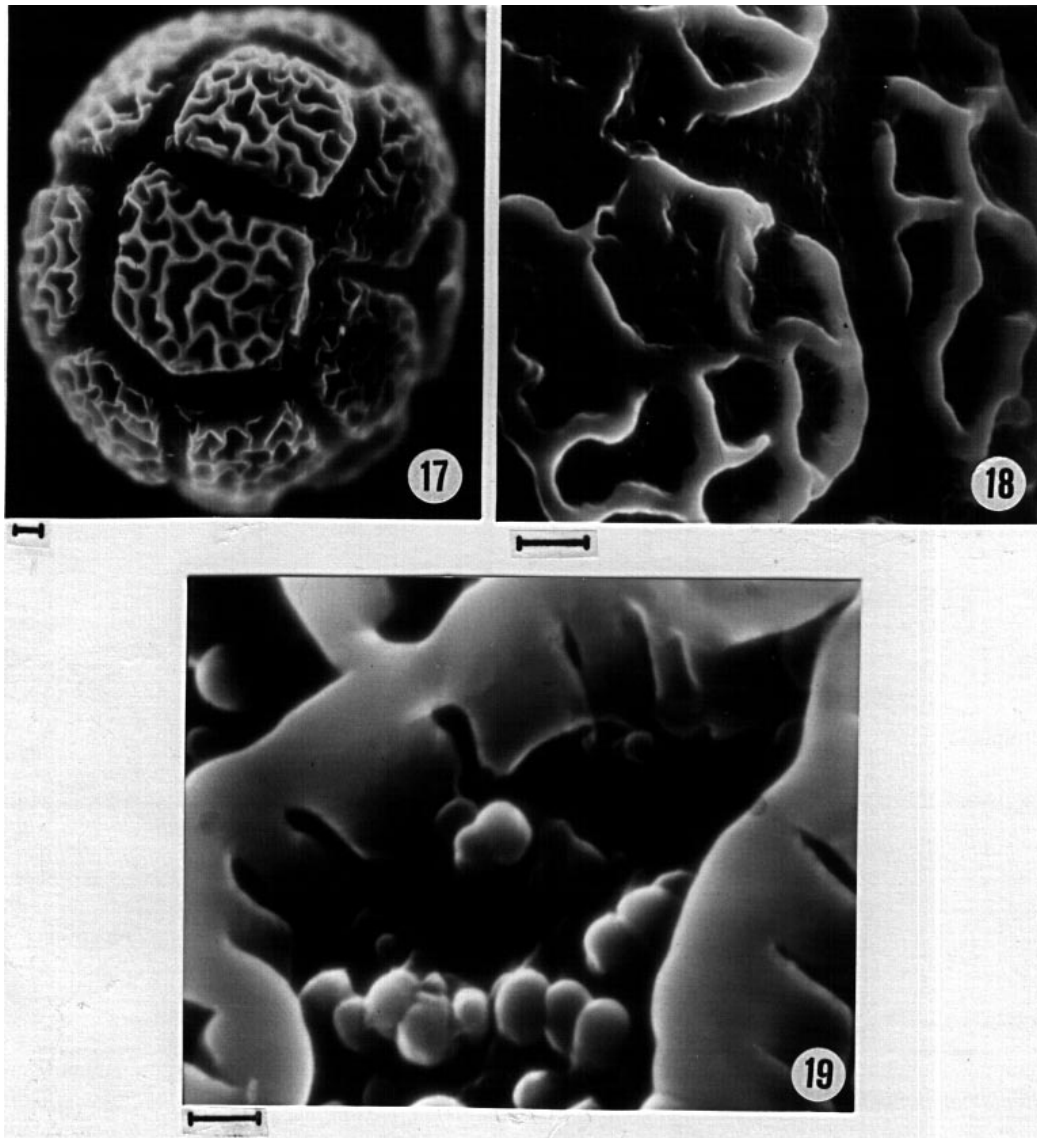
This is part of a study supported by the Scientific and Technical Research Council of Turkey (Project TBAG-1555). We thank Prof. Dr. Adil GÜNER for kindly permitting to us use his *Iris* collection at HUB. We also thank the Electron Microscope Unit of Science Faculty of Ankara University for allowing us access to the SEM.



Figures 1-8. Selected LM pollen micrographs of *Iris* subgenus *Scorpiris*. Whole pollen grains, high focus: 1. *I. aucheri*, EOD 91-AAD, 2. *I. caucasica* ssp. *caucasica*, AAD 1702 a, 3. *I. caucasica* ssp. *turcica*, AG 1437, 4. *I. pseudocauucasica*, AG 1627, 5. *I. stenophylla* ssp. *stenophylla*, AG 1580, 6. *I. stenophylla* ssp. *allisonii*, MK 9585, 7. *I. galatica*, EO11-LO, 8. *I. persica*, AG 1596. Scale bar = 10 μ m.



Figures 9-16. Selected LM pollen micrographs of *Iris* species subgenus *Scorpiris*. Details of pollen surface, high focus: 9. *I. aucheri*, AG 1668, 10. *I. caucasica* ssp. *caucasica*, AAD 1702 a, 11. *I. caucasica* ssp. *turcica*, N. Çelik 1131, 12. *I. pseudocaucasica*, AG 1627, 13. *I. stenophylla* ssp. *stenophylla*, AG 1580, 14. *I. stenophylla* ssp. *allisonii*, MK 9585, 15. *I. galatica*, AG 1475, 16. *I. persica*, AG 1631. Scale bars: Fig. 9=0.2 μ m, Fig. 10=0.8 μ m, Fig. 11=0.3 μ m, Fig. 12=0.6 μ m, Fig. 13-14=0.4 μ m, Fig. 15=0.5 μ m, Fig. 16=0.7 μ m.



Figures 17-19. Selected SEM pollen micrographs of some *Iris* species subgenus *Scorpiris*. 17. *I. persica*, AG 1586, whole pollen grain, 18. *I. stenophylla* ssp. *allisonii*, MK 9585, details of exine shields and surface of grooves, 19. *I. aucheri*, EOD 91-AAD, close-up view of lumen showing columellae and basal granulae. Scale bars: Fig. 17=10 μm , Fig. 18=0.05 μm , Fig. 19=0.08 μm .

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