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Pollen Morphology of Jordanian Cruciferae

von

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Abstract

The pollen morphology of 87 plant species of the family *Cruciferae (Brassicaceae)* in Jordan has been studied. The study incorporated scanning and light microscopy, description and measurements of whole grains. The study revealed that the majority of the pollen grains are tricolpate and some are weakly aperturate or inaperturate. The most common shape is the prolate and subspheroidal. The basic surface pattern of the studied grains is a reticulum and the majority of the grains are finely reticulate.

The plant family *Cruciferae (Brassicaceae)* is a large natural family comprising approximately 380 genera and 3000 species.

Members of the family are found in most parts of the world but are mainly concetrated in the north temperate region and more especially in the countries surrounding the Mediterranean basin and in southwestern and Central Asia, where more genera occur than anywhere else in the world (HEYWOOD, 1978).

The family include annuals, biennials or perennial herbs (rarely subshrubs) with watery sap and the herbage often with stellate or branched unicellular hairs.

In Jordan, this family is represented by 64 genera comprising 125 species (Al-EISAWI, 1982).

The purpose of this paper is to present, in illustrated form, some of the diversity and to some extent the range of variation present in the Jordanian species of the family *Cruciferae*.

This study incorporated scanning and light microscopy, description and measurements of whole grains. The most pertinent previous studies on the family are those of

ERDTMAN (1952) and ROLLINS et BANERJEE (1979).

ERDTMAN examined 80 species from 55 genera and also provided a full list of the relevant work of the earlier workers.

ROLLINS and BANERJEE examined the pollen grains of 227 species in 132 genera representing all subfamilial groupings of the family by using the scanning electron microscope.

MATERIALS AND METHODES:

The pollineferous materials were obtained from specimens deposited at the herbaria of the University of Jordan and Yarmouk University. For light microscopy the pollen was prepared by using the acetolysis method of KUMMEL and RAUP (1965). Ten pollen grains were measured for each species with the aid of an ocular micrometer. The measurements include the polar length (P), the equatorial length (E), the polar area index P.A.I. (the ratio of the distance between ends of adjacent furrows and the equatorial diameter of a pollen grain), the pollen grain wall thickness and the relative thickness of the sexine to the nexine (Table 1).

Preparation for the scanning electron microscope consisted of dusting pollen onto specimen aluminium stabs which held a piece of double-stick scotch tape. The stubs were placed in a sputterer coater for 2 minutes (approximately 150 A of gold deposited). After coating, the specimens were viewed with the scanning microscope with an accelerating voltage of 25 KV, Secondary electron images were recorded with an ILFORD film.

RESULTS:

This study confirms the results of ERDTMAN and ROLLINS and BANERJEE that the family *Cruciferae* is stenopalynous. Pollen grains are usually tricolpate. However, some pollen grains are weakly aperturate as in *Myagrum perfoliatum, Erysimum crassipes, Maresia pygmaea* and *Farsetia aegyptiaca* while others have the slightest indication of an aperture as in *Cardamine hirsuta* and *Ricotia lunaria*. The pollen grains of the different species of the genus *Matthiola* and *Anastatica hierochuntica* are non aperturate. In three of the studied species: *Cardaria draba, Chorispora purpurascens* and *Capsella bursa-pastoris* tri- and tetracolpate pollen grains appeared in the same preparation.

The most common pollen grains shapes found in the *Cruciferae* is the prolate and the subspheroidal. Some grains are spheroidal as in *Ochthodium aegyptiacum, Erysimum repandum, Matthiola* ssp., *Cardamine hirsuta, Iberis odorata* and *Diplotaxis erucoides.* Grains only slightly longer than broad are exemplified by those of *Capsella bursa-pasturis, Crambe hispanica, Chorispora purpurascens* and *Clypeola*

jonthlaspi. The basic surface pattern of the studied grains is a reticulum and the majority of the grains are finely reticulate. The lumina are either of the same size over the entire surface of the grain or they tend to be smaller near the poles. Strong reticular patterns with large lumina (3 x 3(4) um are found in the genera *Matthiola* and *Ricota*. The lumina are almost of the same size distributed over the entire surface of the grain from the poles to the equator.

In the majority of the studied grains the sexine is slightly thicker than the nexine or it can reach a 2:1 ratio as in *Cardaria draba, Diplotaxis erucoides, Brassica nigra, Sinapis alba* and *Reboudia pinnata* with the thickest region in the mesocolpus.

It is very clear that the study of the pollen grains of the *Cruciferae* has little taxonomic implications because there appeared to be too little diversity in shape, apertures and sculpturing from which character correlations might be drawn.

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Plate 1: Pollen, light microscope photographs (all photographs are 900x).

A. *Cardaria draba* (Polar view)
B. *Chorispora purpurascens* (Polar view)
C. *Clypeola jonthlaspi* (Polar view)
D. *Isatis lusitanica* (Polar view)
E and F. *Matthiola aspera* (Polar view)
G. *Ricota lunaria* (Polar view)
H. *Sisymbrium irio* (Equatorial view)

Plate 2: Pollen, SEM pictures

A. *Brassica tournefortii* X 2400
B. *Cardaria draba* X 2400
C. *Chorispora purpurascens* X 2400
D. *Diplotaxis villosa* X 2400
E. *Enarthrocarpus strangulatus* X 2400
F. *Eruca sativa* X 1800

Plate 3: Pollen, SEM pictures

A. *Erysimum crassipes* X 2400
B. *Erysimum repandum* X 13500
C. *Farsetia aegyptiaca* X 2400
D. *Isatis lusitanica* X 2400
E. *Lepidium latifolium* X 2400
F. *Malcolmia chia* X 2400

Plate 4: Pollen, SEM pictures

A. *Matthiola arabica* X 2400
B. *Matthiola longipetala* X 2400
C. *Morettia canescens* X 2400
D. *Notoceras bicorne* X 2400
E. *Ochthodium aegyptiacum* X 2400
F. *Rapistrum rugosum* X 1800

Plate 5: Pollen, SEM pictures

A. *Ricotia lunaria* X 2400
B. *Savignya parviflora* X 2400
C. *Schimpera arabica* X 2400
D. *Sinapis alba* X 2400
E. *Sisymbrium irio* X 2400
F. *Sisymbrium orientale* X 2400

Plate 6: Pollen, SEM pictures

A. *Texiera glastifolia* X 2400
B. *Torularia torulosa* X 2400

TABLE 1

Tribe Sisymbrieae	P(um)	E(um)	P/E	Shape	Colpi	P.A.I	Wall thick-ness (um)	Remarks
Sisymbrium bilobum (C.Koch) Grossh.	24.1	17.5	1.37	Prolate	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Sisymbrium irio L.	25	20	1.25	Sub-spheroidal	Tricolpate	0.50	2.5	Sexine thicker than nexine, (2:1), baculate, tectate, very finely reticulate throughout
Descurainia sophia (L.) Webb ex Franti	20	15	1.33	Prolate	Tricolpate	0.55	1.5	Sexine thicker than nexine, weakly baculate, tectate, Reticulum very fine through-out.
Ochthodium aegyptiacum (L.) DC.	22.5	22.5	1	Spheroidal	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Myagrum perfoliatum L.	25	20	1.20	Sub-spheroidal	Tricolpate		2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Texiera glastifolia (DC.) Jaub.et Spach	20	17.5	1.14	Sub-spheroidal	Weakly tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Isatis lusitanica L.	22.5	17.5	1.28	Sub-spheroidal	Tricolpate	0.62	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Schimpera arabica Hochst. et Steud. ex Boiss.	22.5	20	1.12	Sub-spheroidal	Tricolpate	0.50	2	Sexine to nexine (2:1), baculate, tectate, finely reticulate throughout.

Table 1. Cont....

Erysimum crassipes Fischer & C.A. Meyer	25	17.5	1.42	Prolate	Very weakly tricolpate		1.5	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Erysimum oleifolium J. Gay	25	17.5	1.42	Prolate	Very weakly Tricolpate		1.8	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Erysimum repandum L.	25	25	1	Spheroidal	Very weakly tricolpate		1.8	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Tribe Hesperideae Hesperis bicuspidata (Willd.) Poiret	27.5	20	1.37	Prolate	Tricolpate	0.42	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Hesperis pendula DC.	27.5	22.5	1.22	Sub-spheroidal	Tricolpate	0.55	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Malcolmia crenulata (DC.) Boiss.	25	25	1.00	Speroidal	Tricolate	0.60	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Eremobium aegyptiacum (Sprengel) Asch.et Schw.ex Boiss.	20	12.5	1.6	Prolate	Flatly tricolpate		2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Torularia contortuplicata (Stephan)O.E.Schulz	22.5	17.5	1.28	Sub-spheroidal	Tricolpate	0.71	1.5	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughou
Maresia pygmaea (Delile)O.E. Schulz	25	22.5	1.11	Sub-spheroidal	Flatly tricolpate		1.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Lepataleum fillifolium (Willd.) DC.	20	15	1.33	Prolate	Weakly tricolpate		1.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.

Table 1. Cont...

Matthiola arabica Boiss.	22.5	22.5	1	Spheroidal	inaperturate		1.5	Sexine thicker than nexine, baculate, tectate, coarsly reticulate throughout, lumina about 3 x 3 µm.
Matthiola aspera Boiss.	25	25	1	Spheroidal	inaperturate	—	2	Sexine thicker than nexine, baculate, tectate, coarsly reticulate, lumina about 4x3µm
Matthiola longipetala (Vent.) DC.	25	25	1	Spheroidal	inaperturate	—	3	Sexine thicker than nexine, baculate, tectate, coarsly reticulate.
Matthiola parviflora (Schousb.) R.Br.	25	25	1	Spheroidal	inaperturale	—	3	Sexine thicker than nexine, haculate, tectate, coarsly reticulate.
Matthiola livida (Delile) DC.	25	25	1	Spheroidal	inaperturlate	—	2	Sexine thicker than nexine, baculate, tectate, coarsly reticulate lumina about 3x3µm
Morettia canescens Boiss.	17.5	15	1.4	Prolate	Tricolpate	0.5	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Morettia parviflora Boiss.	25	20	1.25	Sub-spheroidal	Weakly tricolpate	—	1.5	Sexine thicker than nexine, haculate, tectate, finely reticulate throughout.
Notoceras bicorne (Solander) Caruel	25	17.5	1.42	Prolate	tricolpate	0.44	1.5	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Chorispora purpurascens (Banks et Sol.) Elg	25	22.5	1.1	Sub-spheroidal	Tricolpate and Tetracolpate	0.55	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Anastatica hierochuntica L.	32.5	32.5	1	Spheroidal	inaperturate	—	2	Sexine thicker than nexine, baculate, tectate, reticulate throughout.

Table 1. Cont...

Tribe Arabideae Nasturtium officinale R.Br.	20	17.5	1.14	Sub-spheroidal	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Cardamine hirsuta L.	25	25	1	spheroidal	Very weakly tricolpate to inaperturate	——	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Arabis nova Vill.	25	20	1.25	Sub-spheroidal	Weakly tricolpate	——	2.5	Sexine thicker than nexine, (thickest in the mesocolpi) baculate, tectate, finely reticulate throughout.
Farsetia aegyptiaca Turra	25	17.5	1.42	Prolate	Flatly tricolpate	——	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Tribe Alysseae Ricotia lunaria (L.) DC.	30	25	1.2	Sub-spheroidal	inaperturate	——	2.5	Sexine thicker than nexine (2:1), baculate, tectate, reticulate coarse throughout.
Fibigia clypeata (L.) Medikus	47.5	32.5	1.46	prolate	Tricolpate (Syncolpate)	0.6	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate throughout.
Alyssum aureum (Fenzl) Boiss.	25	17.5	1.42	prolate	Weakly tricolpate	0.62	2	Sexine thicker than nexine baculate, tectate, finely reticulate throughout.
Alyssum damascenum Boiss. et Gaill.	40	25	1.6	prolate	Tricolpate	0.94	3	Sexine thicker than nexine (2:1), baculate, tectate, finely reticulate throughout.
Alyssum dasycarpum Steph. ex Willd.	25	20	1.25	Sub-spheroidal	Tricolpate	0.6	3	Sexine thicker than nexine baculate, tectate, finely reticulate.
Alyssum iranicum Hausskn. et Baumg.	30	20	1.5	prolate	Tricolpate	0.7	2.5	Sexine thicker than nexine baculate, tectate, finely reticulate.

Table 1. Cont..

Alyssum linifolium Steph.ex Willd.	25	20	1.25	Sub-spheroidal	Very Weakly Tricolpate	___	2	Sexine thicker than nexine, baculate,tectate,finely reticulate.
Alyssum minus (L.) Rothm.	32.5	22.5	1.44	prolate	Very weakly tricolpate	___	2.5	Sexine thicker than nexine, baculate, tectate,finely reticulate throughout.
Lobularia arabica (Boiss.) Muschl.	22.5	20	1.12	Sub-spheroidal	Weakly tricolpate	___	2.25	Sexine thicker than nexine, baculate,tectate,finely reticulate throughout.
Lobularia libyca (Viv.) Webb et Berth.	22.5	17.5	1.28	Sub-spheroidal	Very weakly tricolpate (inaperturate)	___	2.0	Sexine thicker than nexine, baculate,tectate,finely reticulate throughout.
Clypeola aspera (Grauer) Turrill	27.5	22.5	1.22	Sub-spheroidal	Tricolpate	0.55	2	Sexine thicker than nexine, baculate, tectate,finely reticulate throughout.
Clypeola jonthlaspi L.	27.5	25	1.1	Sub-spheroidal	Weakly tricolpate	0.7	2	Sexine thicker than nexine, baculate,tectate,finely reticulate throughout.
Erophila minima C.A.Meyer	22.5	20	1.12	Sub-spheroidal	Tricolpate	___	2	Sexine thicker than nexine, baculate, tectate,very finely reticulate through-out.
Erophila verna (L.) Bess.	25	20	1.25	Sub-spheroidal	Tricolpate	0.66	2.5	Sexine thicker than nexine, (2:1), baculate,tectate, very finely reticulate through-out.

Table 1: Cont...

Tribe Lepideae	P	E	P/E	Shape	Colpi	P.A.I.	Wall thick-ness	Remarks
Camelina hispida Boiss.	27.5	20	1.37	Prolate	Tricolpate	-	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Heslia apiculata Fischer, C.A. Meyer et Ave-Lall.	25	20	1.25	Sub-Spheroidal	Inaperturate	-	1.5	Sexine thicker than nexine, baculate, tectate, very finely reticulate
Capsella bursa-pastoris (L.) Medikus	25	22.5	1.1	Sub-Spheroidal	Tri and Tetra colpate	0.62	2	Sexine thicker than nexine, baculate, tectate, finely reticulate thoughout.
Hymenolobus procumbens (L.) Nutt. ex Torr. et. A. Gray	22.5	15	1.5	Prolate	Tricolpate	-	2	Similar to the previous one
Thlaspi perfoliatum L.	25	17.5	1.42	Prolate	Flat tricolpate	-	1.5	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Aethionema carneum (Banks et Sol.) Fedtsch.	22.5	17.5	1.28	Sub-Spheroidal	Weakly tricolpate	-	1.75	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Aethionema heterocarpum J.Gay	22.5	20	1.12	Sub-Spheroidal	Tricolpate	0.66	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Iberis odorata L.	20	20	1.00	Spheroidal	Very weakly tricolpate to inaperturate	0.75	1.75	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout
Biscutella didyma L.	32.5	22.5	1.44	Prolate	Flat tricolpate	-	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout

Table 1: Cont...

Lepidium auchery Boiss.	20	17.5	1.44	Sub-spheroidal	Flat tricolpate	-	1.5	Sexine thicker than nexine baculate, tectate very finely reticulate
Lepidium latifolium L.	17.5	15	1.16	Sub-spheroidal	Tricolpate	0.57	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout
Lepidium sativum L.	17.5	16	1.09	Sub-spheroidal	Very weakly tricolpate	-	1.75	Sexine thicker than nexine, baculate, tactate, finely reticulate
Lepidium spinescens DC.	25	17.5	1.42	Prolate	Tricolpate	0.71	1	Sexine thicker than nexine, baculate, tectate,very finely reticulate throughout
Lepidium spinosum Ard.	25	17.5	1.42	Prolate	Weakly tricolpate	0.85	1	Similar to the previous species
Cardaria draba (L.) Desv.	30	25	1.2	Sub-spheroidal	Tri and tetra colpate	-	3	Sexine thicker than nexine, (2:1),baculate, tectate, finely reticulate
Coronpus squamatus (Forskal) Ascher.	22.5	15	1.5	Prolate	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate,finely reticulate throughout
Tribe Brassiceae Pseuderucaria clavata (Boiss. et Reuter) O.E. Schulz	22.5	17.5	1.28	Sub-spheroidal				Sexine thicker than nexine, baculate, tectate,very finely reticulate throughout
Moricandia nitens (Viv,) Dur. et Barr.	25	20	1.25	Sub-spheroidal	Tricolpate	.62	1.5	Sexine thicker than nexine, baculate, tectate,very finely reticulate through-out.
Moricandia sinaica (Boiss.) Boiss.	25	20	1.25	Sub-spheroidal	Tricolpate	0.62	1.5	Sexine thicker than nexine, baculate, tectate,finely reticulate throughout

Table 1. Cont...

Diplotaxis acris (Forskal) Boiss.	20	12.5	1.6	Prolate	Tricolpate		2	Sexine thicker than nexine, baculate, tectate finely reticulate throughout
Diplotaxis erucoides (L.) DC.	22.5	22.5	1	Spheroidal	Tricolpate	0.42	3	Sexine to nexine (2:1), baculate, tectate, throughout
Diplotaxis harra (Forskal) Boiss.	27.5	22.5	1.22	Sub-spheroidal	Tricolpate	0.66	2	Sexine thicker than nexine, baculate, tectate,finely reticulate thoughout
Diplotaxis villosa Boulos et Jallad	25	25	1.00	Spheroidal	Weakly tricolpate	-	2	Similat to the previous species.
Brassica nigra (L.) Koch	25	25	1.00	Spheroidal	Tricolpate	0.70	3	Sexine to nexine (2:1), baculate, tectate,finely reticulate thoughout
Brassica tournefortii Gouan	25	25	1.00	Spheroidal	Tricolpate	0.66	2.5	Sexine thicker than nexine, baculate, tectate,finely reticulate throughout.
Sinapis alba L.	30	25	1.2	Sub-spheroidal	Tricolpate	0.76	2.5	Sexine to nexine (2:1), baculate, tectate,finely reticulate throughout.
Sinapis arvensis L.	20	12.5	1.6	Prolate	Very weakly tricolpate	-	2.5	Sexine to nexine (2:1), baculate, tectate,very finely reticulate throughout.
Hirschfeldia incana (L.) Lagreze-Fossat	25	25	1.00	Spheroidal	Flat tricolpate	-	2	Sexine thicker than nexine, baculate, tectate,finely reticulate thoughout.
Eruca sativa Miller	22.5	17.5	1.28	Sub-spheroidal	Flat tricolpate	-	1.5	Sexine thicker than nexine, baculate, tectate,very finely reticulate throughout.

Table 1. Cont...

Carrichtera annua (L.) DC.	22.5	17.5	1.28	Sub-spheroidal	Tricolpate	0.62	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Sayignya parviflora (Delile) Webb	30	25	1.2	Sub-spheroidal	Flat tricolpate	-	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Reboudia pinnata (Viv.) O.E.Schulz	25	25	1.00	Spheroidal	Tricolpate	0.63	2.5	Sexine to nexine (2:1), baculate, tectate, finely reticulate throughout.
Erucaria boveana Cosson	22.5	17.5	1.28	Sub-spheroidal	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Erucaria pinnata (Viv.) Täckholm et Boulos	25	20	1.25	Sub-spheroidal	Tricolpate	0.60	2	Sexine thicker than nexine, baculate, tectate, very finely reticulate.
Cakile maritima Scop.	30	27.5	1.09	Sub-spheroidal	Very weakly tricolpate	-	2.5	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Rapistrum rugosum (L.) All.	30	25	1.2	Sub-spheroidal	Flatly tricolate	-	2	Sexine to nexine (2:1), baculate, tectate, very finely reticulate throughout
Crambe hispanica L.	27.5	25	1.1	Sub-spheroidal	Tricolpate	0.6	3	Sexine to nexine (2:1), baculate, tectate, finely reticulate throughout.
Crambe orientalis L.	20	15	1.33	Sub-spheroidal	Tricolpate	0.62	2	Sexine thicker than nexine, baculate, tectate finely reticulate throughout.
Raphanus aucheri Boiss.	30	20	1.66	Prolate	Tricolpate	-	2.5	Sexine to nexine (2:1), baculate, tectate very finely reticulate.

Table 1. Cont...

Raphanus raphanistrum L.	37.5	27.5	1.36	Prolate	Flatly tricolpate	-	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.
Raphanus sativus L.	25	20	1.25	Sub-spheroidal	Tricolpate	0.62	2	Sexine to nexine (2:1), baculate, tectate, very finely reticulate.
Xanthrozelpus strangulatus Boiss.	25	22.5	1.11	Sub-spheroidal	Flatly tricolpate	-	2	Sexine thicker than nexine, baculate, tectate, finely reticulate throughout.

Plate 1:

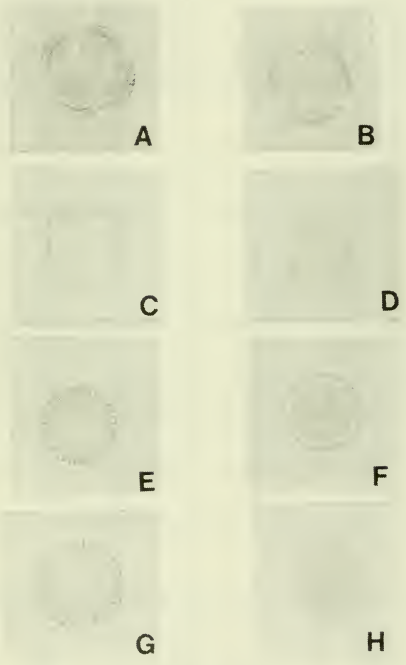


Plate 2 :

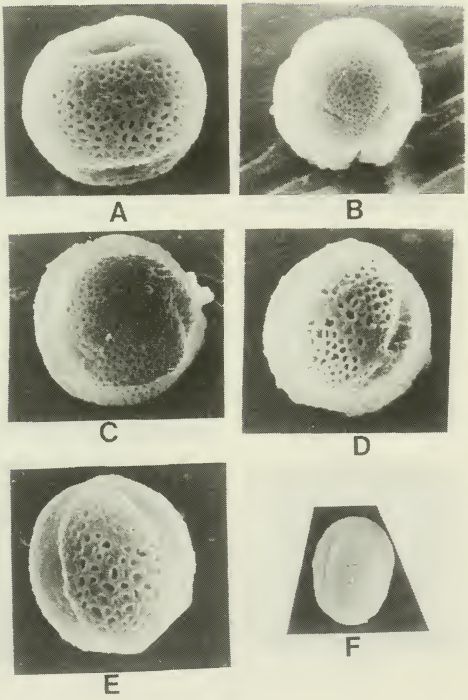
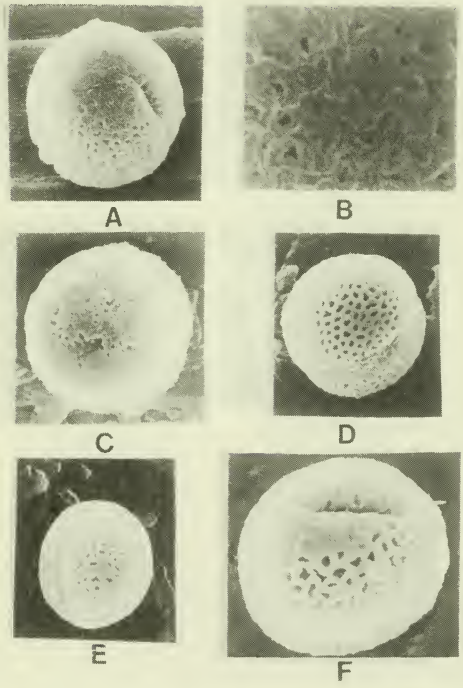


Plate 3 :



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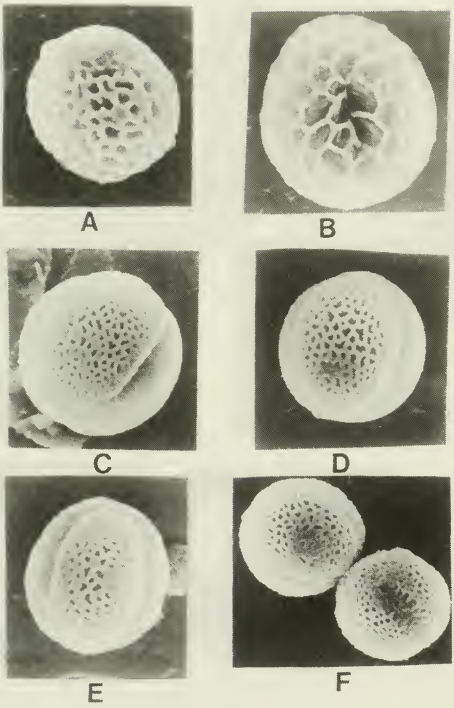


Plate 5 :

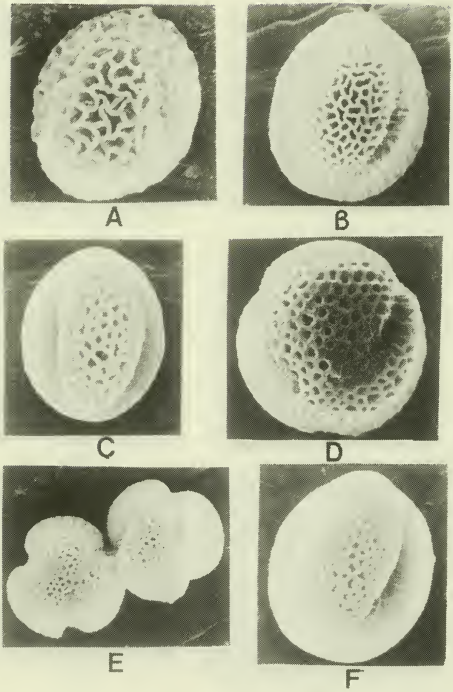
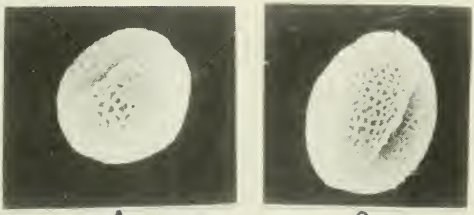


plate 6 :



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