

**STUDIES ON THE POLLEN MORPHOLOGY OF THE
GENUS *SISYMBRIUM* AND MONOTYPIC GENERA
ATELANTHERA AND *ARCYOSPERMA*
(BRASSICACEAE) FROM PAKISTAN**

REHANA KHAN

*Department of Botany,
Federal Urdu University of Arts, Sciences & Technology,
Karachi, Pakistan.*

Abstract

Pollen grains of 8 species belonging to 3 genera viz., *Atelantha*, *Arcyosperma* and *Sisymbrium* (Brassicaceae) from Pakistan were studied by light microscope. Pollen grains usually radially symmetrical isopolar, prolate spheroidal, prolate and subprolate, tectum reticulate to granulated. On the basis of number of aperture two distinct pollen types are recognized. *Atelantha* pollen type 6 colporate and *Sisymbrium* pollen type 3-4 colporate. Palynological data has been useful at generic and specific levels.

Introduction

Palynology is the science of pollen and spore morphology. The palynology can be used as an instrument of multiple research for systematic botany, paleobotany, paleoecology, pollen analysis, aeropalynology, criminology, allergy stratigraphic correlation of oil bearing rocks and coal fields, and improvement of honey.

The family Brassicaceae is one of the largest among the angiosperms with world wide distribution having over 3000 species, in over 350 genera mainly in north temperate zone particularly in Mediterranean region (Mabberly, 1987). In Pakistan 92 genera and 250 species are distributed (Jafri, 1973). The genus *Sisymbrium* includes 70 species in temperate zone of which it is represented by 8 species in Pakistan. *Atelantha* and *Arcyosperma* are monotypic genera in Pakistan (Jafri, 1973). Chiguraeva (1973) examined the pollen morphology of the family Brassicaceae in relation to taxonomy. Javed & Naqshi (1976) also utilized pollen data in the classification of the family Brassicaceae. Jonsell (1986) during monographic studies of Brassicaceae also examined pollen morphology of the family.

Pollen morphology of the family Brassicaceae has been examined by Erdtman (1966); Sharma & Nair (1973); Carter *et al.*, (1975); Moore & Webb (1978); Appel & Al-Shehbaz (2002). Khan (2003, 2004) examined pollen morphology of the genus *Allyssum* and *Arabidopsis*. In the present paper the pollen morphology of 8 taxa representing 3 genera of the family Brassicaceae has been examined by light microscope.

Materials and Methods

The palynological investigations are based on the herbarium material obtained from Karachi University Herbarium (KUH). The pollen slide were prepared by the acetolysis

method as suggested by Erdtman (1966). Measurement of about 10 grains of each species were taken and photograph made on Kodak Pantomix 16 DIN rolls under oil immersion.

For detailed description of the pollen grains the terminology of Erdtman (1952, 1966) has been used. However, some terms have also been borrowed from Faegri & Iversen (1964), Kremp (1965) and Walker & Doyle (1975).

Measurement for the Polar axis (P) equatorial diameter (E), colpi length, apocolpium, mesocolpium and exine thickness were made for each sample by light microscope.

General pollen characters of the genera *Atelanthera*, *Arcyosperma* and *Sisymbrium*

Pollen grains isopolar, prolate spheroidal to prolate, 3-colpate, 6-colporate, syncolpate, small to medium size, sexine more or less as thick as nexine, tectum reticulate. Two distinct pollen types are recognized 3-colpate, 6-colporate.

Key to the pollen types

- 1 + Pollen grain 6- colporate Group-I
 - Pollen grain 3 colpate Group-II

Pollen type: *Atelanthera perpusilla* type (Fig. 1).

Pollen class: 6-colporate.

P/E Ratio: 37.4-22.0 μm .

Shape: Prolate, medium size.

Aperture: Long sunken with acute ends.

Exine: Sexine much thick as nexine.

Measurement: Polar axis 37.4 μm colpi 27.5-3.3 μm ; long or a circular, mesocolpia 13.2 μm in diameter, exine 3.3 μm in diameter, tectum granulated.

Species included: *Atelanthera perpusilla*, (Fig. 1).

Pollen type: *Sisymbrium irio* type (Figs. 1-4).

Pollen class: 3-colpate.

P/E Ratio: 22-33 μm , 19-25 μm .

Size: Small to medium.

Aperture: Colpate and syncolpate, colpi variation in length very long to very short, broad in the middle and acute in the end.

Exine: Sexine much thicker than nexine, more or less as thick as nexine.

Outline: Isopolar, Inter-subangular, slightly circular.

Measurement: Polar axis 22-36 μm , equatorial diameter, 20-31 μm , exine 1.1-4.4 μm , colpi range from 16.5 x 1.1 – 27.5 x 3.3 μm long, mesocolpium 16.5 μm – 22.0 μm in diameter, apocolpia 3.3-5.5 μm in diameter.

Species included: *Arcyosperma permulifolium*, *Sisymbrium heteromallum*, *S. irio*, *S. brassiciforme*, *S. loeselii*, *S. orientale* *S. officinale*.

Fig. 1. Light micrograph of the pollen grains of *Arcyosperma permulifolium*: A. Polar view, B. Equatorial view. *Atelantha perpusilla*: C. Polar view.

Key to the species

- 1 + Pollen grains 3-colpate *Arcyosperma permulifolium*
- Pollen grains 4-colpate 2
- 2 + Pollen grains prolate *Sisymbrium brassiciforme*
- Pollen grains prolate spheroidal..... 3
- 3 + Colpi 13.5 x 2.2 µm long *S. irio*
- Colpi 17.0 x 2.2 µm long 4
- 4 + Mesocolpia 13.2 µm in diameter apocolpia absent *S. officinale*
- Mesocolpia 17 µm in diameter apocolpia 5.5 µm 5
- 5 + Polar axis 11 (19) 22 µm, exine 2.2 thick *S. loeselii*
- Polar axis 2 (22) 27 µm, exine 4.4 µm thick 6
- 6 + Equatorial diameter 22-28 µm *S. heteromallum*
- Equatorial diameter 19-25 µm *S. orientale*

Fig. 2. Light micrographs of the pollen grains of *Sisymbrium brassiciformis*: A. Polar view, B. Equatorial view. *S. loeselii*: C. Polar view, D. Equatorial view. *S. officinale*: E. Polar view, F. Equatorial view.

Fig. 3. Light micrographs of the pollen grain of *Sisymbrium heteromallum*: A. Polar view, B. Polar view. Polar view 4-colpate, C. Equatorial view.

Comments

Brassicaceae is stenopalynous family (Perveen & Qaiser, 2004). Pollen grains are generally prolate to subprolate, spheroidal 3-colpate often 4-6 colpate as *Atlanthera perpusilla* 6-colporate pollen, tectum reticulate to granulated. Apple & Shehbaz (2003) also reported tricolpate pollen in the family Brassicaceae. Moore and Webb (1987) also described tricolpate with reticulate pollen in the family. Khalik (2002) divided family on the basis of lumina size. However considerable variation in this genera number of aperture and shape of pollen has been observed. The genus *Sisymbrium* is distinct by having 3-4 colpate, syncolpate and prolate spheroidal to subprolate shape pollen. However on the basis of number of aperture two distinct pollen types are recognized. *Atelentera perpusilla* type and *Sisymbrium irio* type. The *Atelentera perpusilla* type is easily recognized by having 6-colporate and granulated tectum, one species is included in this pollen type. *Atelentera perpusilla*.

The *Sisymbrium irio* type. This pollen type is characterized by having 3-4 colpate, reticulate tectum prolate to prolate spheroidal pollen grain (see key to the species), 7 species are included in this type: *Arcyosperma permulifolium*, *Sisymbrium brassiciforme*, *S. loeselii*, *S. officinale*, *S. heteromallum*, *S. irio* and *S. orientale* (Table 1).

Table 1. Summary of the pollen morphological data of the genus *Sisymbrium*.

Name of species	P (μm)	E (μm)	Shape	Size	No. of aperture	Apocolpium	Mesocolpium (μm)	Length of colpi (μm)	Exine thickness (μm)
<i>Sisymbrium brassiciforme</i>	22 (25) 27	16 (20) 22	Prolate	Small	03	Absent	15.4	18 x 2.2	2.2 – 4.4
<i>S. loeselii</i>	11 (19) 22	13 (16) 19	Subprolate	Small	03 (Syncolpate)	Absent	13.2	17 x 2.2	2.2
<i>S. officinale</i>	19 (21) 23	17 (18) 21	Prolate-spheritodal	Small	3	Absent	13.2	17 x 2.2	2.2 – 3.3
<i>S. heteromallum</i>	22 (28) 33	22 (23) 28	Prolate-spheritodal	Medium	4	Absent	24.2	22 x 2.0	2.2
<i>S. irio</i>	17 (23) 27.5	23 (21) 17	Prolate-spheritodal	Small	3 – 4	3.3	17.6	13.5 x 2.2	1.1 – 4.4
<i>S. orientale</i>	21 (22) 77	19 (20) 25	Prolate-spheritodal	Medium	3	5.5	17.0	17 x 2.2	2.2 – 3.3

Key to abbreviation: P= Polar axis; E= Equatorial diameter.

Fig. 4. Light micrographs of the pollen grains of *Sisymbrium irio*: A. Polar view, B. Equatorial view. *S. orientale*: C. Polar view, D. Equatorial view.

Acknowledgement

I am highly indebted to the Director of the Karachi University Botanical Herbarium (KUH) for providing the specimens used in the study. My thank are also Prof. Dr. Qaiser Abbas, Federal Urdu University of Arts, Sciences and Technology, Karachi for the encouragement and support. My thanks are also to Dr. Anjum Perveen of Karachi University for co-operation.

References

- Appel, O. and I.A. Al-Shehbez. 2002. Cruciferae. In: Families and genera of vascular plants (K. Kubitzki) volume; V. Flowering Plant Dicotyledons Maludles, Capparales and Non-Betalain Caryophollaceae. K. Kubitzki, C. Bayer 75-174. Springer-Verlartg Berlin Heidelberg, New York.
- Carter, A.L., S.T. Rilloms and T. Meneilly. 1975. Scanning electron microscope studies of pollen behaviour on immature and mature brussels sprout (*Brassica oleracea* var. *gemunifera*) Stigmas. *Euphytica.*, 24: 133-141.
- Chiguriaeva, A.A. 1973. Pollen morphology of Cruciferae in pollen and spore morphology of recent plant (in Russian). *Pora-3rd Int. Palynology Conf. Acad. Sci., USSR.*, 93-98: 3 pl.
- Erdtman, G. 1952. *Pollen morphology and plant taxonomy. Angiosperms.* Chronica Botanica Co., Waltham, Massachusetts.
- Erdtman, G. 1966. *Pollen morphology and plant taxonomy. Angiosperms* (An introduction of palynology revised edition), Hanerphthb. Co. New York London.
- Faegri, K. and J.K. Iversen. 1964. *Text book of pollen analysis.* Munksgaard, Copenhagen.
- Javed, G.M. and A.R. Naqshi. 1976. Pollen grains as an aid to taxonomy of Brassicaeae. *Int. Symp. Physiology of sexual reproduction in flowering plants.* Dept. Bot. Punjab Agricultural University Abstract A-6.
- Jafri, S.M. 1973. *Flora of West Pakistan.* No. 55 Brassicaeae. Department of Botany, University of Karachi.
- Jonsell, B. 1986. A monograph of *Farsetia* (Cruciferae). *Acta. Univ. UPS. Symp. Bot. Up. Sal.*, 25(3): 107.
- Khalik, K.N.A. 2002. *Biosystematic studies on Brassicaeae (Cruciferae) in Egypt.* Ph.D. dissertation.
- Kremp, G.O.W. 1965. *Encyclopaedia of pollen morphology.* Univ. Arizona Press, Tuscon, U.S.A.
- Mabberley, D.I. 1987. *The plant book.* Camb. Univ. Press, Cambridge, New York.
- Moore, P.D. and J.A. Webb. 1978. *An illustrated guide to pollen analysis.* Hoader and Stoughton, London.
- Khan, R. 2003. Studies on the pollen morphology of the genus *Alyssum* (Brassicaceae) from Pakistan. *Pak. J. Bot.*, 35(1): 7-12.
- Khan, R. 2004. Studies on the pollen morphology of the genus *Arabidopsis* (Brassicaceae) from Pakistan. *Pak. J. Bot.*, 36(2): 229-234.
- Perveen, A., M. Qaiser and R. Khan. 2004. Pollen flora of Pakistan XLII. Brassicaceae. *Pak. J. Bot.*, 36(4): 683-700.
- Selling. 1974. Studies in Hawaiian pollen statistics Part-II the pollen of the Hawaiian. Phanerogams. Spac. Public Bishop Mus. Gothenbrig.
- Sharma, P.K. and P.K.K. Nair. 1973. Study on the pollen production in *Brassica.* *Palynological Bulletin*, 6(2): 62-66.
- Walker, J.W. and J.A. Doyle. 1975. The basis of *Angiosperm Phylogeny Palynology.* *Ann. Bot. Gard.*, 62: 666-723.

(Received for publication 12 November 2004)