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POLLEN FLORA OF PAKISTAN -LVI. CUCURBITACEAE

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Abstract

Pollen morphology of 10 species representing 7 genera of the family Cucurbitaceae from Pakistan has been examined by light and scanning electron microscope. Pollen grains are usually radially symmetrical, isopolar, oblate-spheroidal to prolate-spheroidal rarely sub-prolate or sub-oblate. Sexine slightly thicker or thinner than nexine. Tectum mostly coarsely reticulate or reticulate-rugulate rarely verrucate-scabrate. On the basis of exine pattern and apertural types three distinct pollen types are recognized viz., *Cucumis melo*-type, *Momordica charantia*-type and *Solena amplexicaulis*-type.

Introduction

Cucurbitaceae is a family of about 120 genera and 825 species (Mabberely, 1987) mostly distributed in the tropical countries poorly represented in temperate regions. In Pakistan it is represented by 17 genera and 32 species (Nazimuddin & Naqvi, 1984).

Plants are mostly prostrate or climbing herbaceous annuals characterized by 5-angled stems and coiled tendrils, leaves alternate, palmately 5-lobed or divided; exstipulate, flowers unisexual rarely bisexual, actinomorphic, calyx of 5 sepals, tubular fused to ovary wall, Corolla of 5 petals, androecium is highly variable, consisting of basically 5 distinct to completely connate stamens twisted, folded or reduced in number, gynoecium compound pistil of 1-10 carpels, inferior ovary with one locule and usually numerous ovules, parietal placentae, fruit pepo. Cucurbitaceae is important as a source of food, like pumpkin (*Cucurbita pepo*), melon (*Cucumis melo*), cucumber (*Cucumis sativus*), water melon (*Citrullus lanatus*), *Lagenaria siceraria* (bottle gourd) and *Luffa cylindrica* (sponge gourd).

Pollen morphology of the family has been examined by Erdtman (1952), Marticorena (1963), Jeffery (1964, 1967, 2006), Salard-Cheboldaeff, (1978, 1994), Qaiser & Perveen (1997), Muller (1985), Khunwasi (1998), Stafford & Sutton (1994), Pruesapan & Vander Ham (2005) examined the pollen morphology of the genus *Trichosanthes* of the family Cucurbitaceae. Moore & Webb (1978) also examined pollen morphology of few species of the family Cucurbitaceae. There are no reports on pollen morphology of the family Cucurbitaceae from Pakistan. Present investigations are based on the pollen morphology of 9 species representing 7 genera of the family Cucurbitaceae by light and Scanning Electron Microscope.

Materials and Methods

Polleniferous material was obtained from Karachi University Herbarium (KUH) or collected from the field. The list of voucher specimens is deposited in KUH. The pollen grains were prepared for light (LM) by the standard methods described by Erdtman (1952). For light microscopy, the pollen grains were mounted in unstained glycerin jelly

and observations were made with a Nikon Type-2 microscope, under (E40, 0.65) and oil immersion (E100, 1.25), using 10x eye piece. For SEM studies, pollen grains suspended in a drop of water were directly transferred with a fine pipette to a metallic stub using double sided cello tape and coated with gold in a sputtering chamber (Ion-sputter JFC-1100). Coating was restricted to 150 A. The S.E.M examination was carried out on a Jeol microscope JSM-2. The measurements are based on 15-20 readings from each specimen. Polar axis (P) and equatorial diameter (E), aperture size, apocolpium, mesocolpium and exine thickness were measured (Tables 1-2).

The terminology used is in accordance with Erdtman (1952), Kremp (1965), Faegri & Iversen (1964) and Walker & Doyle (1975).

General pollen characters of the family Cucurbitaceae

Pollen grains are usually radially symmetrical, isopolar, porate or colporate, oblate-spheroidal to prolate-spheroidal rarely sub-prolate or sub-oblate, Sexine slightly thicker or thinner than nexine. Tectum mostly coarsely reticulate rarely reticulate often verrucate. On the basis of exine pattern and apertural types three distinct pollen types are recognized viz., *Momordica charantia*-type, *Cucumis melo*-type and *Solena amplexicaulis*-type.

Key to the pollen types

1 + Pollen grains colporate ……..… 2
- Pollen porate …… *Cucumis melo*-type

2 + Tectum reticulate or rugulate-reticulate……... *Momordica charantia*-type
- Tectum verrucate ..…….…….. *Solena amplexicaulis*-type

Pollen type: *Cucumis melo*-type (Fig. 1 A-E).
Pollen class: Porate
P/E ratio: 72-79.0
Shape: Sub-oblate to oblate.
Apertures: Pore circular
Exine: Sexine thicker than nexine
Ornamentation: Coarsely reticulate or reticulate-rugulate
Measurements: Size: Polar axis P = 30 (36.75 ± 1.2) 43.5, and equatorial diameter E = 43 (33.54 ± 2.1) 56.5 µm. Pore 5.8 (7.9± 1.4)–10 µm diameter. Exine 1.7-2 .0 µm thick, sexine as thick as nexine. Tectum coarsely reticulate or reticulate-rugulate.
Species included: *Mukia maderaspatana* (L.) M.J. Roem, *Cucumis melo* ssp. *agrestis* (Naud.) Grebens and *Cucumis prophetarum* L.

Key to the species

1 + Pollen grains sub-oblate ……..... 2
- Pollen grains oblate ……..…… *Mukia maderaspatana*

2 + Tectum reticulate ……...……..…… *Cucumis melo* ssp. *agrestis*
- Tectum reticulate-rugulate …….……. *Cucumis prophetarum*

Table 1. General characters of pollen grains found in the pollen type-*Cucumis melo*.

Name of taxa	Shape	Polar axis (P) in µm	Equatorial diameter (E) µm	Colpus length in µm	Exine thickness in µn	Tectum
Mukia maderas patana (L.) M.J. Roem	Oblate	30.0 (32.03±0.71) 35.10	37.50 (44.20±1.50) 52.50	7.50 (9.53±0.93) 10.0	2.25 (2.34±0.04) 2.50	Medium reticulate
Cucumis melo L. ssp. *agrestis* (Naud.) Greberosc	Sub-Oblate	37.0 (39.32±0.28) 42.50	46.25 (49.50±0.35) 56.50	10.0 (12.80±0.33) 15.0	2.0 (2.28±0.03) 2.50	Medium reticulate
Cucumis prophetarum L.	Sub-Oblate	35.90 (39.80±0.43) 43.08	43.08 (47.50±0.60) 50.26	5.38 (7.85±0.58) 10.77	1.79 (2.58±0.11) 2.81	Reticulate-rugulate

Table 2. General characters of pollen grains found in the pollen type-*Momordica charantia*.

Name of taxa	Shape	Polar axis (P) in µm	Equatorial diameter (E) µm	Colpus length in µm	Exine thickness in µn	Tectum
Monordica charantia L.	Sub-Pr	50.0 (60.0±2.41) 87.50	45.0 (50.78±1.90) 58.75	25.0 (38.12±3.80) 55.0	2.50 (3.18±0.11) 3.50	Coarsely reticulate
M. dioica Roxb. ex Willd.	Sub-Pr	59.25 (67.34±1.30) 72.50	47.50 (55.60±1.08) 61.50	42.50 (50.57±1.40) 60.0	2.25 (2.78±0.11) 3.50	Coarsely reticulate
Cterolepis cerasidormis (Stocks) Hook.f.	Pr-Sp	c. 41.25	c. 40	c. 30	c. 2.5	Coarsely reticulate
Citrullus colocynthis (L.) Schard	Ob-Sp	47.32 (58.78±1.78) 71.81	53.23 (59.23±1.2) 64.62	39.49 (42.42±3.40) 43.08	1.79 (2.28±0.21) 3.59	Coarsely reticulate
Coccinia grandis (L.) Voigt	Pr	47.61 (59.35±1.26) 64.62	35.91 (40.63±0.91) 44.80	53.85 (58.15±0.89) 61.03	2.87 (3.30± 0.17) 3.95	Coarsely reticulate

Abbreviation: Pr-Sp= Prolate-spheroidal, Sub-Pr= Sub-prolate, Pr= Prolate, Ob-Sp= Oblate-spheroidal

Pollen type: *Momordica charantia*-type (Fig. 1F, Fig. 2 A-C)
Pollen class: Tricolporate
P/E ratio: 98-114
Shape: Sub-prolate to prolate or oblate-spheroidal
Apertures: Colpus long sunken with acute ends
Exine: Sexine thicker or thinner than nexine
Ornamentation: Medium to coarsely reticulate
Measurements: Size: Polar axis P =41.75 (58.75 ± 1.2) 75.25, and equatorial diameter E = 35 (48.7± 2.1) 62.5 µm. Colpi 25.61 (49.95 ± 1.4)–68.25 µm long. Exine 1.79-3.75 µm thick, sexine thicker than nexine. Tectum medium coarsely reticulate.
Species included: *Citrullus colocynthis* (L.) Schard., *Coccinia grandis* (L.) Voight, *Momordica charantia* L**.,** *M.dioica* Roxb. ex Willd., *Ctenolepis cerasiformis* (Stocks) Hook.f.

Key to the species

1 + Pollen grains subprolate to prolate or prolate-spheroidal ……..... 2
- Pollen grains oblate-spheroidal ……..… *Citrullus colocynthis*

2 + Pollen grains prolate or prolate-spheroidal ……..……. 3
- Pollen grains sub-prolate …...……. group-1
(*Momordica charantia***,** *M.dioica*)

3. + Pollen grains prolate …… *Coccinia grandis*
- Pollen grains prolate-spheroidal …...…… *Ctenolepis cerasiformis*

Pollen type: *Solena amplexicaulis*-type (Fig. 2 D & E).
Pollen class: Tricolporate
P/E ratio: 1.33
Shape: Prolate
Apertures: Colpus short sunken with acute ends
Exine: Sexine slightly thinner than nexine
Ornamentation: Verrucate
Measurements: Size: Polar axis P = 46.25 (48.72 ± 1.2) 51.25, and equatorial diameter E = 35 (36.8 ± 2.1) 41.12 µm. Colpi 40.25.61 (23 ± 1.4)–45.1 µm long. Exine c. 2.5 µm thick, sexine as thick as nexine. Tectum verrucate
Species included: *Solena amplexicaulis* (Lam.) Gandhi

Discussion

Cucurbitaceae is a more or less eurapalynous family. Significant variation in exine pattern and apertural types has been observed. Almost all type of shape class have been found within the family, but sub-oblate or sub-prolate are more frequent. Two types of apertures i.e., porate and colporate are found. Tectum commonly reticulate rarely reticulate-rugulate often verrucate. On the basis of apertural types and exine pattern, the family has been divided into three pollen types, viz., *Momordica charantia*- type, *Cucumis melo*-type, and *Solena amplexicaulis*-type. Jeffrey (2005) divided the family Cucurbitaceae into two subfamilies. Subfamily Nhandiroboideae representing a single tribe Zanonieae (Zanonioideae) and subfamily Cucurbitoideae is subdivided into ten tribes viz., 1. Joliffieae (Subtribe Telfairiinae, Thladianthinae), 2. Bryonieae, 3. Trichosantheae Subtribe Ampelosicyinae, Hodgsoniinae, Trichosanthinae), 4. Herpetospermeae, 5. Schizopeponeae, 6. Tribe Luffeae, 7. Sicyeae, (Subtribe Cyclantherinae, Sicyinae), 8. Coniandreae, 9. Benincaseae (Subtribe Benincasinae), 10. Cucurbiteae.

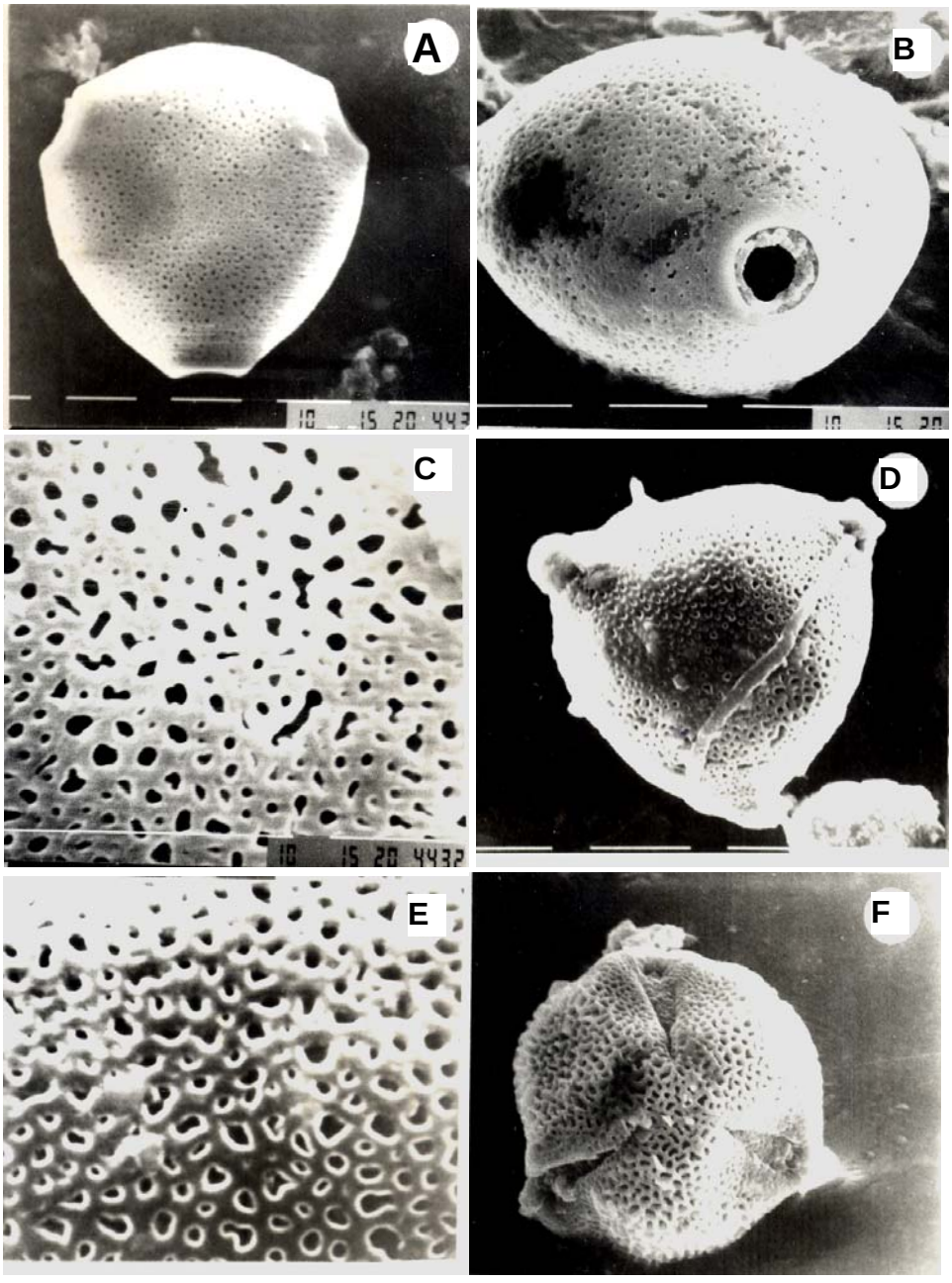

Fig. 1. Scanning Electron micrographs of pollen grains.: A, *Cucumis melo* ssp. *agrestis* Polar view, B, Equatorial view; C, Exine pattern. *Mukia maderspatana*: D, Polar view; E, Exine pattern. *Ctenolepis cerasiformis* F, Polar view.
Scale bar = 10 um.

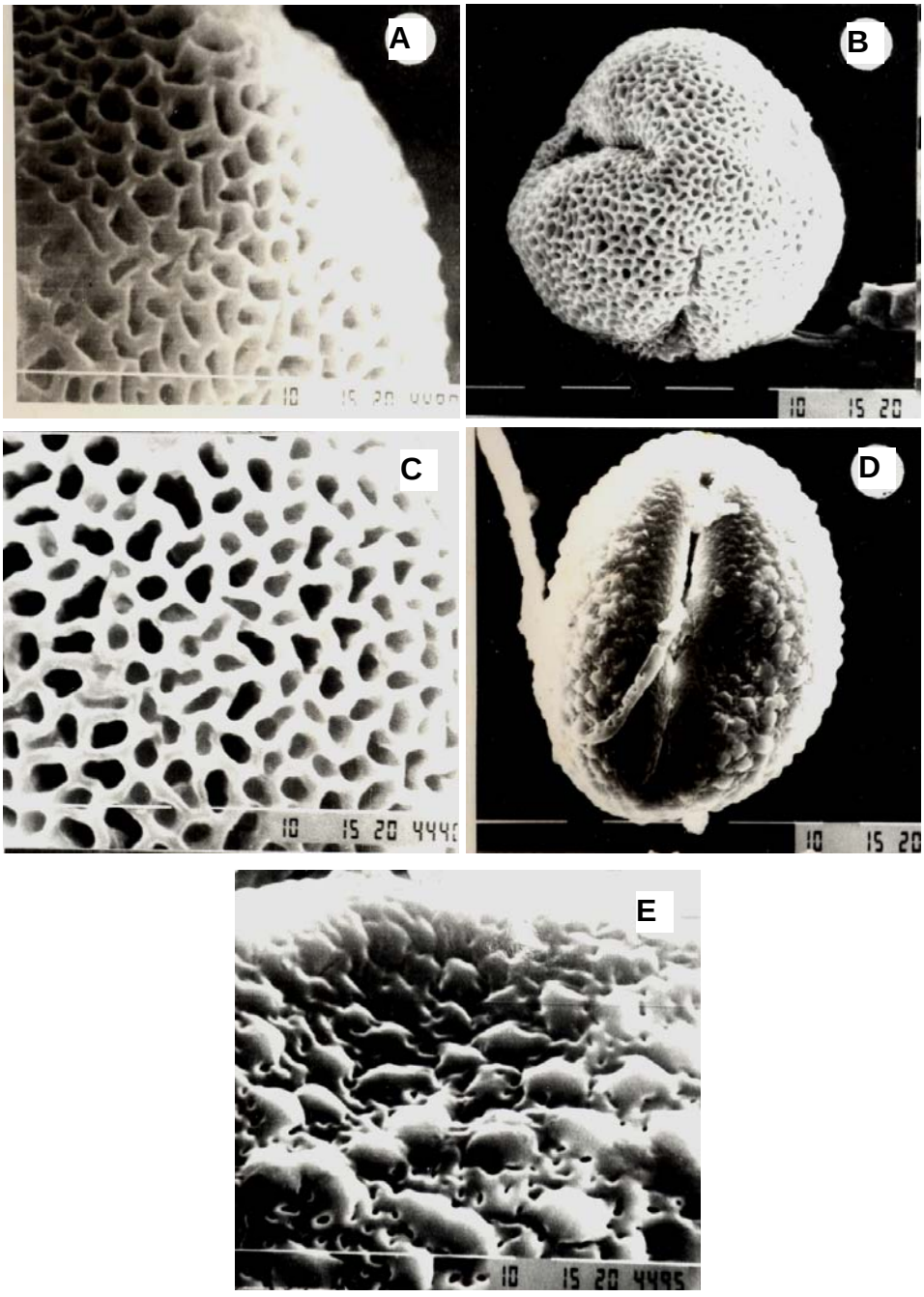

Fig. 2. Scanning Electron micrographs of pollen grains. *Ctenolepis cerasiformis*: A, Polar view; *Momordica charantia*: B, Polar view, C, Exine pattern. *Solena amplexicaulis*: D, Equatorial view; E, Exine pattern
Scale bar = 10 um.

Cucurbitaceae are among those few families of flowering plants in which pollen carries phylogenetic signal at higher (tribal) levels (viz., Cucurbiteae, Sicyeae). Among the earliest fossils of the family is the pollen *Hexacolpites echinatus* from the Oligocene of Cameroon (Salard-Cheboldaeff, 1978, Muller, 1985); these pollen grains under the light microscope are hexacolpate or stephanocolpate and resemble polycolpate pollen of New World clade Sicyeae.

Pollen grains of the family Cucurbitaceae are monads rarely tetrads, tectate to semitectate. Nhandiroboideae pollen is always tricolporate and less than 40 µm in diameter. The exine is usually striate. Whereas Cucurbitoideae pollen grains are more than 180 um in diameter (rarely >200 µm in some *Cayaponia* and *Polyclathra* (Khunwasi, 1998) with reticulate or echinate exine and porate or colpate apertures (Barth *et al.*, 2005).

The most recent subfamilial and tribal classification of Cucurbitaceae (Jeffrey, 2005) is largely supported by molecular data (chloroplast data) eight of the 11 tribes almost exactly as circumscribed by Jeffrey. However, tribes Joliffieae and Trichosantheae are poly- and paraphyletic (Kocyan, 2007).

All the studied taxa belong to the subfamily Cucurbitoideae. With few exceptions, the three pollen types recognized correspond closely to Jeffery (2005) tribal and subtribal classification and most of the tribes are easily distinguished palynologically, for example species of pollen types-I are found in the tribe Benincaseae: subtribe Cucumerinae, where as pollen types – II & III commonly found in the sub tribe Benincasinae of tribe Benincaseae (except *Momordica*). The genus *Momordica* belong to the tribe Joliffieae subtribe: Thladianthinae.

References

Barth, O.M., C.F. Pinto da Luz and V.L. Gomes-Klein. 2005. Pollen morphology of Brazilian species of *Cayaponia* Silva Manso (Cucurbitaceae, Cucurbiteae), *Grana*, pp. 129-136.

Erdtman, G. 1952. *Pollen Morphology and Plant Taxonomy. Angiosper*ms. Chronica Botanica Co., Waltham, Massachusettes. Copenhagen.

Faegri, K. and J. Iversen. 1964. *Text book of Pollen Analysis*. Munksgaard,

Jeffrey, 2005. A new system of Cucurbitaceae, *Bot. Zhurn*., 90: 332-335.

Jeffrey, C. 1964. A note on pollen morphology in Cucurbitaceae, *Kew Bull*., 17: 473-476.

Jeffrey, C. 1967. On the classification of the Cucurbitaceae, *Kew Bull*., 20: 417-426.

Jeffrey, C. and W.J.J.O. De Wilde. 2006. A review of the subtribe Thladianthinae (Cucurbitaceae), *Bot. Zhurn*., 91: 766-776.

Khunwasi, C. 1998. *Palynology of the Cucurbitaceae*. Doctoral Dissertation Naturwiss. Fak., University of Innsbruck.

Kocyan, A., Zhang, Li-Bing, H. Schaefer and S.S. Renner. 2007. A multi-locus chloroplast phylogeny for the Cucurbitaceae and its implications for character evolution and classification. Molecular Phylogenetics and Evolution, 44(2): 553-577.

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.

Marticorena, C. 1963. Material para una monografia de la morfologı´a del polen de Cucurbitaceae, *Grana Palynol*., 4: 78-91.

Moore, P.D. and J.A. Webb. 1978. *An Illustrated Guide to Pollen Analysis*. Hodder and Stoughton, London.

Muller, J. 1985. Significance of fossil pollen for angiosperm history, *Ann. Missouri Bot. Gard*., 71: 419-443.

Nazimuddin, S. and S.S. Naqvi. 1984. Cucurbitaceae. In: *Flora of Pakistan*. (Eds.): E. Nasir & S.I. Ali. 154: 4-43.

Pruesapan, K. and R. Van der Ham. 2005. Pollen morphology of *Trichosanthes* (Cucurbitaceae), *Grana*, 44: 75-90.

Qaiser, M. and A. Perveen. 1997. A Palynological Survey of Flora of Pakistan. In: *Proceedings of Int. Symp. on Plant Life of South West Asia and Central Asia*. (Eds.): M. Ozturk, O. Secmen and G. Gork.

Salard-Cheboldaeff, M. 1978 Sur la palynoflore Maestrichtienne et Tertiaire du bassin sédimentaire littoral du Cameroun. *Pollen et Spores*, 20: 215-260.

Stafford, P.J. and D.A. Sutton. 1994. Pollen morphology of the Cyclantherinae C. Jeffr. (tribe Sicyeae Schrad., Cucurbitaceae) and its taxonomic significance, *Acta Bot. Gallica*, 141: 171182.

Walker, J.W. and J.A. Doyle. 1975. The basis of Angiosperm phylogeny: Palynology. *Ann. Mo. Bot. Gard*., 62: 666-723.

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