POLLEN MORPHOLOGY AND TAXONOMY OF THE TRIBE SOPHOREAE (FABACEAE)

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Abstract

Pollen morphology of 40 species belonging to 4 genera of the tribe Sophoreae (Fabaceae) has been studied. Generic delimitations and interspecific relationship within the tribe have been assessed. Palynological findings have been correlated with related tribes of the family for better palynotaxonomical and phylogenetic understanding of the group.

Introduction

The Tribe Sophoreae comprises 48 genera (Hutchinson, 1964); Airy Shaw, 1973) and is taxonomically characterised by free stamens, non-jointed pods and odd pinnate to rarely simple leaves in addition to other common fabaceous features. Bentham (1865) treated the tribe next to Dalbergieae and placed as the last tribe of Papilionaceae before Caesalpineae.

Sophoreae is represented by 5 genera (s. l.) in India, viz., *Dalhousia* R. Grah, *Sophora* Linn., *Calpurnia* E. Mey., *Pericopsis* Thw. and *Ormosia* Jack. Except *Pericopsis* which is represented in India by single species *P. mooniana* Thw. all the other genera have been investigated.

The pollen morphology of the tribe Sophoreae has been meagrely worked out by Mohl (1835) Hassall (1842), Cranwell (1942), Selling (1947) Vishnu-Mittre and Sharma (1962), Huang (1968, 1972), Heusser (1971) and Ohashi, (1975) mostly in relation to regional flora. Recently Guinet (1981) and Ferguson and Skvarla (1981) gave only a synoptic information on the pollen morphology of the Leguminosae in general. Considering the lack of palynological informations of the tribe an attempt has been made to present a detail palynological data on the Indian and available foreign materials with emphasis on pollen morphology and its application in taxonomy.

Material and methods

The polliniferous material was collected from the authentic herbarium sheets of the Central National Herbarium (CAL). Pollen slides were prepared by acetolysis method (Erdtman, 1952) and have been deposited in the sporothek of palynological laboratory, CAL. For measurements, mean of 25 readings have been taken from acetolysed non-chlorinated pollen grains for each taxon. Terminology of Erdtman (1969) and Faegri and Iversen (1964) have been followed. Salient pollen morphological feature have been given in the Table 1. Only latest valid names have been cited in the table and basionyms as well as synonyms are given for reference in the list of materials studied. New names (*sensu stricto*) with the previous names are given in the text for better understanding of the taxon from palynotaxonomical point of view.

Material studied

Calpurnea aurea Baker, India: M. P., Panchmari, V. Narayanaswami—3503. Africa: Schimperi inter Alyssinicum. u. i.—1840, CAL—133241. C. floribanda Harv., S. Africa Peddie dist, R. D. A. Bayliss—5602. *C. intrusa* E. Mey, S. Africa: T. Cooper—856 (1862), Inanda, J. M. Wood—956. *C. lasiogyna* E. Mey, Africa Herb. Natal Bot. Gard. J. M. Wood—102; Natal,

Table 1—Summary of pollen morphological features of the tribe Sophoreae (Fabaceae)

Taxa		Outline in eq.view (contour)	SIZE PXE μm Mean	EXINE Thickness	Sculpture Pat.	Sculpture Lumina size	APERTURE Type	APERTURE Ecto. (Colpus)	APERTURE Endo. (Os=Pore)	Remarks
1	2	3	4	5	6	7	8	9	10	11
Calpurnia aurea Baker	Pro.Sph.	Comp.oval	22.5-31×23-30 / 27×26	1-1.5	ret.	±1	3-colpr.	slit.	lolong	Sex. thicker than nex., Ex. thicker at apocolpium. Endoap. rectangular type, foot layer and col. heads distinct.
C. floribunda Harv.	Pro.	Ellip.oval	23-31×18-24 / 26.5×21	1.5	Obs.	—	3-colpr.	slit.	lolong	Sex.=nex.
C. intrusa E. Mey	Pro.	Ellip.oval	22-29×16-23 / 35×19	1-1.2	Psi.	—	3-colpr.	slit.	lolong	Colpus constricted at equator, sex= nex., Ex. thicker at apocolpium.
C. lasiogyna E. Mey	Pro.-Pr.Sph	Comp.oval	22.5-30×22-28 / 26.5×25	1.5	ret.	1-1.25	3-colpr.	slit.	lolong	Sex.=nex., colpus constricted at the equator, ret. distinct at apocolpium.
C. sylvatica E. Mey	Pro.	Comp.oval	26-33×24-32 / 31×28.5	±2	ret.	1.2-1.5	3-colpr.	tap.	lolong	Sex. thicker than nex., eq. margin of the endoap. indistinct.
Dalhousia africana S. Moore	Pro.Sph.	Comp.oval	28-36×26-34 / 34×32.5	2	ret.	±1	3-colpr.	tap.	lolong	Colpus margin smooth, endoap. granulated, margin indistinct, sex. thicker than nex.; foot layer, col. and col. heads distinct.

(**Table 1**—*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
Dalhousia bracteata Grah. ex Benth.	Pro.Sph.	Comp.oval	18-23×19823.5 / 20×20.5	1.8	micro-ret.	±0.5	3-colpr.	tap.	lalong	Colpus margin irregular, endoap. margin indistinct, sex.= nex., col. distinct with distinct heads, lumina size in apocolpium ± 1/μm.
Fedorovia laxa (Prain) Yakovlev	Pro.sph.-Pro.	Comp.oval	27-35×23.5-33 / 31×29	2	obs.	—	3-colpr.	tap.	lalong	Colpus constricted at equator, sex. thicker than nex., col. indistinct.
F. striata (Dunn.) Yakovlev	Pro.-sph.	Comp.oval	24-32×21-30 / 28.5×26	±2	psi.	—	3-colpr.	tap.	lalong	Colpus constricted at equator, sex. thicker than nex. thicker than sex. at apocolpium, col. indistinct.
Ormosia assamica Yakovlev	Pro.	Ellip.oval	31-38×27-35 / 36×32	2	ret.	1.5-2	3-colpr.	tap..	lalong	Pollen grains comperatively larger than the other spp. of the genus. Col. distinct. Double layer of columellae observed. Endoap. rectangular.
O. bancana (Mig.) Merr.	Pro.Sph.	Comp.oval	26-34×25-32 / 30×28.5	2	ret.	±1	3-colpr.	tap.	lalong	Sex. thicker than nex., endoap. rectangular type, equatorial margin indistinct, colpus constricted at the equator.
O. dulse Prain	Pro-Pro. sph.	Ellip.oval	23.5-32×21-27 / 28×23.5	±2	ret.	1	3-colpr.	tap.	lalong	Sex.=nex. Colpus constricted at the equator. Col. distinct.

Table 1—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
O. emarginata Benth.	Pro.Sph.	Comp.oval	25-34×23-31 / 28.5×26	2	ret.	1-1.5	3-colpr.	tap.	lolong	Sex.=nex., colpus constricted at the equator. Eq. margin of the endoap. indistinct. Lumina larger at poles.
O. hoaensis Prain	Pro.	Fllip.oval	21.5-31×21-27 / 27×23	1.75-2	ret.	1	3-colpr.	slit.	lolong	Sex. thicker than nex. Ex. thicker at poles. Endoap. ornate type.
O. macrodisca Baker	Pro.-Sph.	Comp.oval	21-27×21-26 / 24×22.5	1.75	micro-ret.	0.5-0.75	3-colpr.	tap.	lalong	Sex.=nex., ret. finer towards aperture, endoap. rectangular.
O. microsperma Baker	Pro.Sph.	Comp.oval	23-32×23-30.5 / 29×28	2	f.ret.	0.75-1	3-colpr.	tap.	lalong	Sex.=nex. colpus constricted at the equator. Eq. margin of endoap. indistinct.
O. pinnata (Lour) Merr.	Pro.	Ellip.oval	26-33×24-31 / 29.5×25.5	2	ret.	1-1.5	3-colpr.	tap.	lalong	Sex.=nex., ret. heterobrochate, finer towards aperture. Colpus constricted at the equator. Col. distinct.
O. polita Prain	Pro.-Pro. sph.	Comp.oval	24.5-33×26-32 / 29.5×27.5	1.5-2	f. ret.	0.75-1	3-colpr.	tap.	lolong	Sex. thicker than nex., Ex. thin at mesocolpium, lumina larger at poles and finer towards aperture.
O. scandens Prain	Pro-sph.	Comp.oval	26.5-34×26-32.5 / 30.5×28	1.5	f. ret.	0.75	3-clopr.	slit.	lolong	Endoap. area granulated.
O. sumatrana(Miq.) Prain	Poo.	Ellip.oval	24.31×21.30 / 27+23.5	1.5	obs.	—	3-colpr.	slit.	lolong	Endoap. area indistinct.

Table 1—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
Placolobium gracilis (Prain) Yakovlev	Pro.sph.	Comp.oval	24.5-33.5 ×24-31 / 29.5×28	2	ret.	1	3-colpr.	slit	lalong	Sex.=nex., Eq. margin of the endoap. indistinct.
P. travancorica (Bedd.) Yakovlev	Pro.	Ellip.oval	30.5-38.5 ×28-36 / 35.5×33	2-2.25	ret.	1.5-2	3-colpr.	slit	lolong	Sex. thicker than nex., ex. thicker at poles. Endoap. area gradnulated, heterobrochate.
Ruddia fordiana (Oliv.) Yakovlev	Pro.	Ellip.oval	24-33 ×22-30.5 / 30×26.5	2-2.25	rug. ret.	1-1.5	3-colpr.	tap.	lalong	Sex. thicker than nex. ret. heterobrochate, finer towards aperture. Col. distinct.
Sophora ardexa Grah.	Pro.-Pro.sph.	Ellip.oval	19.5-29 ×19.5-27.5 / 24.5×23.5	1.5	rug.ret.	±0.5	3-colpr.	slit	lolong	Sex.=nex. colpus constricted at the eq., col. indistinct.
S. benthami V. Steen.	Pro.	Ellip.oval	22-30 ×19-24 / 25.5×22.5	1.5-2	ret.	±1	3-colpr.	tap.	lolong	Sex.=nex., Col. indistinct, Ex. thicker at poles, colpus constricted at the eq.
S. flavescens Ait. var. *flavescens*	Pro.	comp.oval	(24.5)-26--34× (18)-21-29 / (26)-30.5×(21.5)-27	±2	f. ret.	0.5-1	3-colpr.	tap.	lalong	Sex.thicker than nex. at poles, colpus constricted at eq., eq. margin of endoap. indistinct, lumina larger at poles. Mat. from Japan shows smaller size range and finer reticulation.
S. heptaphylla Linn.	Pro.	Ellip.oval	22-29 ×19.5-26.5 / 26.5×23	1.5	ret.	±1	3-colpr.	slit	lolong	Sex.=nex., Col. indistinct.
S. interrupta Bedd.	Pro.-Pro. Sph.	Comp.oval	24-31 ×21-26 / 29.5×24.5	1-1.75	f. ret	±1	3-colpr.	tap.	lolong	Colpus constricted at the eq. Endoap. gr., Sex. =nex.

Table 1—(*Contd.*)

1	2	3	4	5	6	7	8	9	10	11
S. japonica Linn. var. *japonica*	Pro.	Ellip.oval	23-30 × 21-25.5 / 26 × 23	1.5-2	ret.	1-1.25	3-colpr.	tap.	lolcmg	Sex.=nex., Ex. thicker at poles, col. indistinct.
S. littoralis Schrad	Pro.	Ellip.oval	24.5-31 × 21-29 / 26 × 23.5	1.5-2	ret.	±1	3-colpr.	tap.	lolong	Sex.=nex. col. indistinct at mesocolpium, colpus constricted at the equator.
S. mollis Grah. var *griffithii* (Stock) Tsoong	Pro.-pro. sph.	Ellip. oval	21-30.5 × 21-27 / 27.5 × 24	±2	ret.	1-1.25	3-colpr.	slit	lolong	Sex.=nex., Lumina larger at poles.
S. mollis Grah. var. *mollis*	Pro.-Pro sph.	Ellip.oval	25.5-32 × 23-29 / 30 × 27.5	±2	ret.	1-1.5	3-colpr.	slit	lolong	Sex.=nex., lumina larger at poles. Pollen grain size is the only difference with other var. studied.
S. moocroftiana Benth.	Pro.-Pro. sph.	Comp. oval	23-30.5 × 22-28.5 / 27 × 25.5	1.5	ret.	1-1-25	3-colpr.	slit	lolong	Sex.=nex., col. indistinct, lumina size larger at poles.
S. pachicarpa Schrenk ex C. A. Mayer	Pro.sph.	Comp.oval	(17-)24-32 × 22-30 / 30 × 28.5	2	ret.	1-1.75	3-colpr.	slit	lolong	Sex.=nex., Col. indistinct at mesocolpium, lumina larger at poles. Rarely ob. sph. grains observed.
S. prazeri Prain var. *prazeri*	Pro.sph.	Comp.oval	22-28 × 19-23 / 25.5 × 23	±2	f. ret.	±1	3-colpr.	tap.	lolong	Sex. thicker than nex., colpus constricted at the eq., eq. margin of the endocap. indistinct.
S. tomentosa Linn. var. *tomentosa*	Pro.	Comp.oval	26-35 × 18-29 / 31.5 × 26.5	1.5	f. ret.	0.5-0.75	3-colpr.	slit	lolong	Endoap. rectangular type, eq. margin indistinct, heterobrochate.

Table 1—*(Contd.)*

1	2	3	4	5	6	7	8	9	10	11
										In the aperture area nexine departed from the sexine and intruded inward forming vestibulum (Faegri and Iversen, 1964).
S. velutina Lin. var. *velutina*	Pro-Pro. Sph.	Comp. oval	21-26×18-24.5 / 24×22	1-1.5	rug.-ret.	(1-)1.5	3-colpr.	tap.	lolong	Colpus constricted at the eq., endoap. area gr., rarely gr. extends through colpus length, Sex.=nex. ret. finer towards aperture.
S. wightii Baker	Pro.	Ellip. oval	24-29.5(-36.5) ×19.5-23.5(-31) / 26×22	2	f. ret	±1	3-Colpr.	tap.	lolong	Sex.=nex., colpus constricted at the eq.
Trichocyamus pachycarpa (Camp. ex Benth.) Yakovlev	Pro.-Pro.sph.	Comp. oval	26.5-35×24-32 / 31×28	2.5	ret.	(0.75-) 1-1.5	3-colpr.	tap.	lalong	Colpus constricted at the eq., endoap. rectangular type, Sex. thicker than nex., heterobrochate, ret. finer towards aperture. Ap. membrane gr. Double layer of exine stratification is observed.
Vexibia alopecuroides (Spach. ex Jaub. et Spach.) Yakovlev	Pro.-Pro.sph.	Ellip.oval	(18-) 23-31 ×21-29.5 / 29.5×28	±2	ret.	1-1.5	3-colpr.	slit	lolong	Sex.=nex., Col. indistinct. Ex. thicker at poles. Some smaller grains also observed.

Abbreviations used: Ap.-Aperture; Col.-columella; comp. oval—compressed oval; colpr.—colporate; E.—Equatorial diameter; Ellip. oval—Elliptic oval; Ex.—Exine; Endoap.—Endoaperture; Ectoap.—Ectoaperture; eq.—equatorial; f. ret.—finely reticulate; gr.—granules granulated; lalong.—lalongate; lolong.—lolongate; Micro-ret.—Micro-reticulate; nex.—nexine; obs.—obscure; Ob. Sph-oblate spheroidal; P.—Polar axis length; Pat.—Pattern; Pro.—Prolate; Pro. Sph.—Prolate-spheroidal; Psi—Psilate; ret.—reticulate; Sex.—Sexime; Slit.—Slit like Sph..—Spheroidal; Tap.—Tapering; var.—variety.

J. M. Wood—6125. *C. sylvatica* E. Mey, Africa: Natal, R. Schlechter—6158.

Dalhousia africana S. Moore, Africa: Congo C. Evrad—5040, CAL—567580. *D. bracteata* Grah. ex Benth., India: Herb. Hort. Cal., J. C. Prazer—75, CAL—133783; Assam, Khasia, Jenkins—262. Bangladesh: Sylhet, NIL—7162, (24-5-1868), CAL—133181.

Fedorovia laxa (Prain) Yakovlev=*Ormosia laxa* Prain, Burma: Kachin Hills, Shaik Mokim, s. n. CAL—133679. *F. striata* (Dunn) Yakovlev=*Ormosia striata* Dunn., China: Yunan, Aug. Henry—41886.

Ormosia assamica Yakovlev=*O. robusta* Baker, Assam: Badal Khan—10; NIL, CAL—133806. *O. bancana* (Miq.) Merr.= *O. parviflora* Baker. Malaya Peninsula: NIL, s. n., Det.—Yakovlev (1967). *O. dulse* Prain, Burma: Shaik Mokim—s. n. Det.—Yakovlev (1967). *O. emerginata* Benth. Hongkong: B. Garden, NIL, s. n. CAL—133675. *O. hoaensis* Prain, Cochin—China: L. Pierre, s. n., CAL—133680. *O. macrodisca* Baker, Singapore: HNR—2103. *O. microsperma* Baker, Malacca: R. Derry—1090. *O. pinnata* (Lour.) Merr.=*O. hainanensis* Gagnep. China: Hainan, F. C. How—72995. *O. polita* Prain=*O. nitida* Prain, Burma: Shaik Mokim, s. n. Det. Yakovlev (1967). *O. scandens* Prain, Malay peninsula: Dr. King's Col.—3560. *O. sumatrana* (Miq.) Prain, China: Yunnan, Aug. Henry—12885, Det.—Yakovlev (1967).

Placolobium gracilis (Prain) Yakovlev= *Ormosia gracilis* Prain, Malay peninsula: Perak, King's Col.—4234. *P. travancorica* (Bedd.) Yokovlev=*Ormosia travancorica* Bedd. Tamil Nadu: Tinnevelly, C. A. Barber—3127, Det.—G. S. Gamble.

Ruddia fordiana (Oliv.) Yakovlev—*Ormosia fordiana* Oliv. China: Hainan, F. C. How—72898.

Sophora ardexa Grah. America: Ex. Horto. bot. Petropolitani, s. n. CAL—133547. *S. benthami* V. Steen.=*S. acuminata* Benth. ex Baker, Meghalaya: *G. gallatly*—258. Sikkim: H. F. Green—835. *S. flavescens* Ait. var. *flavescens*=*S. flavescens* Ait; *S. angustifolia* S. & Z. : *S. flavescens* var. *Stenophylla* Hayata; *S. angustifolia* S. & Z. var. *senophylla* Mak. et Nemoto. Japan: Yakohama, Ex. Herb. Bot. Petropolitani, CAL—133475; Tibet: Tali vally, George Forest—4233; China: Zimmermann—201—*S. heptaphylla* Linn. Srilanka: C. P. Thawaites—570; Herb. Sulp. Kurz—s. n. CAL—133333. *S. interrupta* Bedd. Madras: Beddome, s. n. CAL—133458, Det. J. G. Gamble (1917). *S. japonica* Linn. var. *japonica*=*S. japonica* L. Tamil Nadu: Yarkand, J. Scully—s. n. CAL—133490. China: Yunnan, Fr. Ducloux—7617. *S. littoralis* Schrad, Australia: Communicatum ereliquns Martianis (1875), Aquisitions—Journal Nr. 229, CAL—133580. *S. mollis* Grah. var. *griffithii* (Stock) Tsoong—*S. griffithii* Stocks, *S. mollis* subsp. *griffithii* (Stock) Ali, *Keyserlingia griffithii* (Stock) Bunge ex Boiss. Baluchistan: J. F. Duthie—8642. *S. mollis* Grah. var. *mollis*, N. W. Himalaya—H. B. Royle, s. n. CAL—133427; Afghanistan: H. A. Deane, s. n. Herb. Hort. Bot. Calcuttensis. *S. moocroftiana* Benth. Tibet: King's Col.—1, CAL—133280. *S. pachicarpa* Schrenk ex C. A. Mayer, Afghanistan: J. E. T. Aitchinson—435. *S. prazeri* Prain var. *prazeri*, Burma: Gilbert Rogers—1043; Abdul Khalil—s n. (1896), CAL—133467, *S. tomentosa* Linn. var. *tomentosa*=*S. tomentosa* Linn. Australia: Ferd Mueller, s. n CAL—133564. *S. velutina* Lindl. var. *velutina*=*S. glauca* Lesch. Madras: Coimbatore, C. E. C. Fischer—1056, Det.—G. P. Yakovlev (1967). *S. wightii* Baker—*S. heptaphylla* Auct. non Linn. Wight, Maharashtra: Herb. Hort. Bot. Calcuttensis, NIL, 273B (1879).

Trichocyamus pachycarpa (Camp. ex Benth.) Yakovlev=*Ormosia panchycarpa* eamp. ex Benth. China: NIL, CAL—133684.

Vexibia alopecuroides (Spach. ex Jaub. et Spach) Yakovlev—*Sophora alopecuroides* Linn. Baluchistan: Stocks—1001, CAL 133390.

Observation and discussion

Pollen morphology of Sophoreae reveals that it is a stenopalynous tribe. Pollen isopolar, 3-zonocolporate, medium sized (exceptionally small), prolate or prolate spheroidal (very rarely oblate spheroidal) in equatorial view, polar axis length ranging from 18 to 38.5 μm and equatorial axis diameter ranging from 18-36 μm, either compressed oval or elliptic oval in meridional forms, circular in polar view. Colpi distinct, either narrow slit like or tapering When tapering sometimes with a median constriction at the equator. Colpus membrane generally smooth, sometimes granulated in the endoaperture area and rarely granules extend through the colpus length. OS generally distinct, either lolon-

gate or lalogate type. When lalongate sometimes it is rectangular. Sometimes equatorial margin of the endoapertures are indistinct. Endoaperture area sometimes provided with randomly distributed granules. In *Ormosia hoaensis* endoaperture is ornate type. Exine ornamentation in the tribe is generally reticulate type—either microrecticulate or coarsely recticulate (Praglowski *et al.*, 1973); rarely psilate, obscure or ruguloreticulate. Lumina homobrochate or heterobrochate, when heterobrochate, finer towards aperture and/or coarser at apocolpium region. Exine layers differentiated into tectum, columella and endexine (Erdtman, 1969) (=sexine and nexine—Faegri & Iversen 1964)). In most of the species foot layer is not distinguishable. Exine thickness varies from 1 to 2.5 μm in the tribe. Generally exine is of uniform thickness, sometimes thicker at apocolpium than the mesocolpium region. Columella in most of the species of *Sophora* are indistinct, but distinct with distinct columella heads in the species of *Ormosia Calpurnia* and *Dalhousia*. In most of the taxa sexine is as thick as nexine, but sometimes sexine is thicker than nexine. Exine stratification in the tribe is important because of the fact that in some species of *Ormosia* (s.l.) double layer of columellae are evident. This observation reminds the similar observation of Ferguson and Skvarla (1981) in *Castanospermum* (Leguminosae). A detail SEM observation on the exine stratification of the Tribe, preferably from the ontogenetic point of view, is necessary for the knowledge of such anomalous double layer exine stratification. In *Sophora tomentosa* Linn. var. *tomentosa*, nexine splitted from the sexine in the endoaperture area and bend inward forming a vestibulum (Faegri & Iversen, 1964) which is a specialized pollen character rarely observed in leguminoceous taxa. Detailed pollen morphological characters of individual species studied are given in the Table 1.

Palynological trends in the tribe Sophoreae

Shape (oblate spheroidal)—Prolate spheroidal—Prolate (rare)

Size (Small) (rare)—Medium -Large

Aperture—Ecto: Slit like—Tapering—Tapering, constricted at the equator.

Endo: (Circular)—Lolongate—Lalongate.

Membrane: Smooth—Granulated—random—Ornate.

Exine ornamentation—Psilate/Obscure—Reticulate

a) finely recticulate/microreticulate (lumina upto 1 μm)

b) Coarsely recticulate/(Lumina greater than 1 μm)

c) ruguloreticulate

Columella layer—Single layer—double layer (most anomalous). Indistinct distinct, with distinct head

Palynotaxonomic consideration and affinities

Review of taxonomic literature (Yakovlev, 1972, 1973a, b, 1978; Tsoong, 1980; Tsoong & Machi, 1981) reveals that the nomenclature and identity of a number of taxa of the tribe have been changed from time to time by the taxonomists. As a result 4 genera and 40 species (*sensu lato*) studied palynologically are now validated as 9 genera and 40 species (sensu genera and species nova). Three species of *Ormosia* have been given the gernic status by Yakovlev), viz., *Trichcyamus*, *Placolobium* and *Ruddia* but palynology has nothing to do in support of the creation of new taxa except for *Trichocyamus pachycarpa* (camp. ex Benth.) Yakovlev (=*O. pachycarpa*) which is distinct for its double layer of columellae in the exine. But similar important as well as anomalous feature is also observed in *O. assamica* Yakovlev (=*O. robusta*), *Placolobium travancorica* (Bedd.) Yakovlev (—*O. travancorica*), *P. gracilis* (Prain) Yakovlev (=*O. gracilis*). *Fedorovia laxa* (Prain) Yakovlev (=*O. laxa*), *F. striata* (Dunn) Yakovlev (=*O striata*) and *Ruddia fordiana* (Oliv.) Yakovlev (=*O. fordiana*) all these taxa have been given new rank in taxonomy but they do not show any distinct palynological character in support of their new taxonomic status. There are a number of overlapping characters with other species of *Ormosia*. Similarly *Vexibia alopecuroides* (Spach. ex Jaub. et Spach.) Yakovlev (=*Sophora jaubertii*) shows no additional palynological supporting character in favour of its new status except a few exceptionally smaller pollen grain size, which I belive is more phytogeographical criterion rather than a stable and important specific character. Some exceptionally small pollen grains (20.5 × 18 μm) were also observed in

Sophora flavescens Ait. var. *flavescens* while exceptionally large (36.5×31 μm) in *Sophora wightii* Baker. A few oblate-spheroidal pollen grains have been observed in contrary to the prolate-spheroidal normal ones in *Sophora pachicarpa* Schrenk ex C. A. Mayer. Some new species and variety of *Sophora* created by different authors from time to time have overlapping palynological characters with other species of the genus (Mitra *et al.*, 1979; Mitra & Mondal, 1982) published a detail pollen morphology of the tribe Hedysareae and *Desmodium*. Pollen morphologically *Sophora Ormosia* (some spp.) and *Calpurnia* show similarity with those of the tribe Dalbergieae and genera *Dalhousia* and *Ormosia* (some spp.) with the tribe Hedysareae and Desmodieae (sensu Polhill, 1981). Pollen grains of the tribe Amherstieae and Detarieae of the subfamily Caesalpinioideae (Okolo & Gill, 1987) show some similarity in shape, aperture and exine character. Bentham and Hooker's placement of the tribe Sophoreae as last tribe of Papilionioideae and just before Caesalpinioideae is justified in this regard. Similarity of pollen morphological features of the tribes of Leguminosae (Vishnu—Mittre & Sharma, 1962; Mitra *et al.*, 1969; Mitra & Mondal, 1982; Okolo & Gill, 1989) with Connaraceae (Dickison, 1979; Mondal, 1983, 1986) strengthen their possible common ancestry (Takhtajan, 1966, 1969, 1973).

Conclusion

Sophoreae is a stenopalynous tribe and supports natural grouping in Bentham and Hooker's (1852-1883) system of classification.

The taxa show a gradual trend from unspecialised to derived types of pollen morphoforms.

Creation of new genera is not supported palynologically.

Present study supports the recent phylogenetic scheme proposed by Polhill (1981), though through some bidirectional way. Palynologically Sophoreae links with Dalbergieae on one hand and Hedysareae (s.l.) on the other.

A detail SEM study is needed on the ontogeny of the pollen wall stratification of *Ormosia* for its unique development of double layer of columellae.

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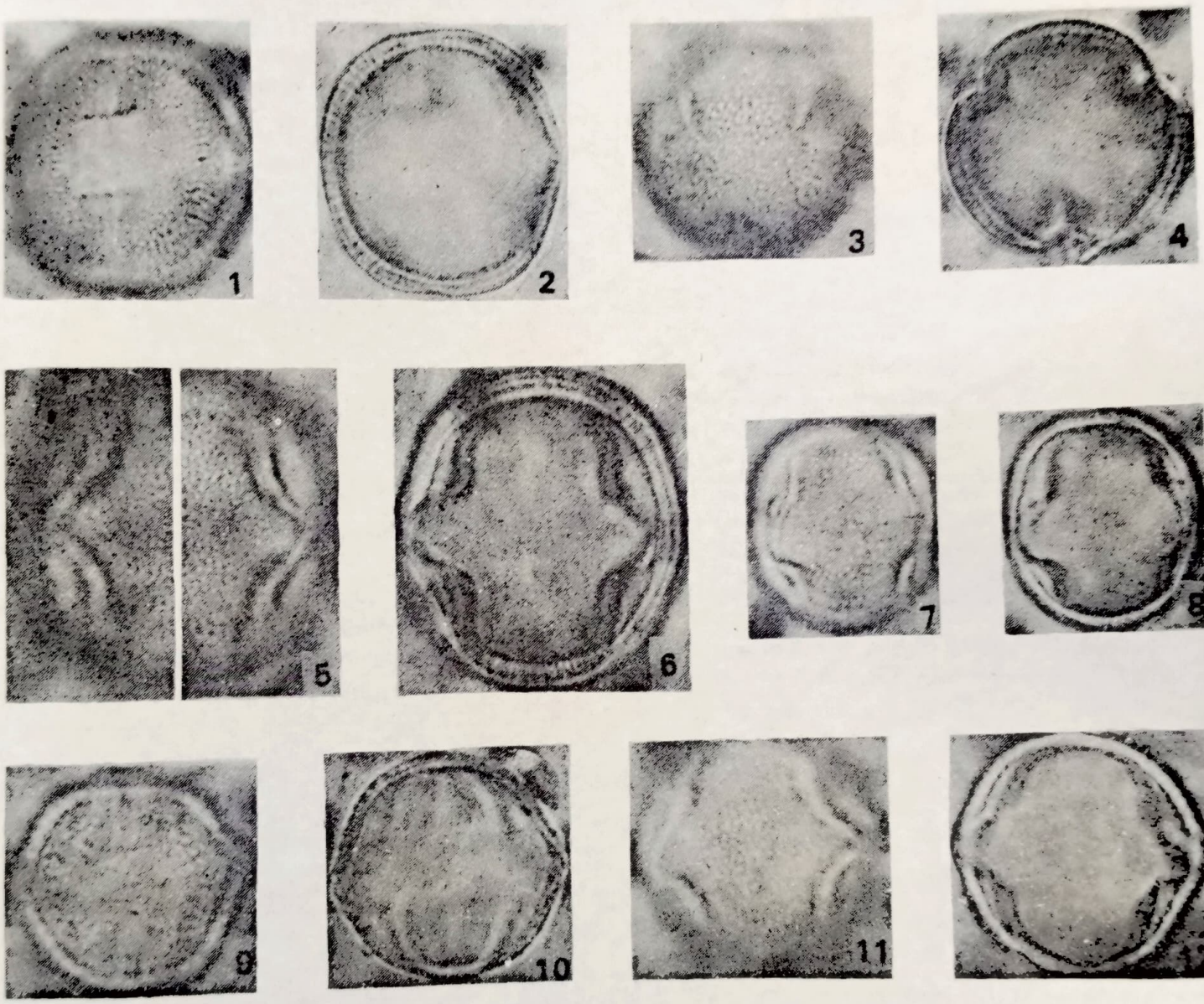
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Explanation of Plate

Plate 1

(All figures ×1000)

1—4. *Trichocyamus pachycarpa* (Camp. ex Benth.) Yakovlev. 1. Aperture rnd details of exine; 2. Optical section meridional showing double layer of columellae; 3. Polar view showing exine in apocolpium; 4. Optical section equatorial.

5—6. *Ormosia assamica* Yakovlev—5. Exine in Ist and 2nd focus; 6. Optical section meridional showing double layer of columellae.

7—8. *Sophora velutina* Lindl. var. *velutina*. 7. Details of exine: 8. Optical section meridional and aperture profile.

9—10. *Calpurnia auria* Baker. 9. Aperture and details of exine; 10. Optical section meridional.

11—12. *Dalhousia africana* S. moore. 11. Details of exine; 12. Optical section meridional and aperture profile.