



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>
Journal DOI: [10.21474/IJAR01](https://doi.org/10.21474/IJAR01)

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

POLLEN MORPHOLOGICAL STUDIES OF 10 ENDEMIC LEGUMES FROM INDIA.

*Anoop P. Balan¹, P.S. Udayan² and S.V. Predeep³

1. Centre for Medicinal Plants Research (CMPR), Arya Vaidya Sala, Kottakkal P.O., Malappuram, Kerala, India - 676503.
2. Department of Botany, Sree Krishna College, Guruvayur, Thrissur, Kerala, India.
3. Department of Botany, S.V.R.N.S.S. College, Vazhoor, Kottayam, Kerala, India.

Manuscript Info**Manuscript History:**

Received: 10 April 2016
Final Accepted: 22 May 2016
Published Online: June 2016

Key words:

Endemic legumes, India, Pollen morphology.

***Corresponding Author**

Anoop P. Balan.

Abstract

The pollen morphology of 10 endemic legumes of India belonging to 10 different genera was studied using Light Microscopy (LM) and Scanning Electron Microscopy (SEM). Great variations observed in the apertural characters and exine ornamentations are found to be significantly helpful at generic as well as species level delimitation. The pollen grains are generally 3-zonocolporate or rarely 3-zonocolpate with ora lalongate or lolongate or circular. The exine ornamentation shows highest variation among genera, from psilate to foveolate, granulate, rugulate, reticulate, scabrate or verrucate. A brief plant description, habit and pollen images, details on nomenclature, phenology, habitat and distribution are also provided with pollen description of each species.

Copy Right, IJAR, 2016. All rights reserved.

Introduction:-

Leguminosae (nom. alt. Fabaceae) with approximately 727 genera and 19,327 species (Lewis *et al.*, 2005), is the third largest family of flowering plants after Orchidaceae and Asteraceae, occupies a special place among the angiosperms. Legumes are a significant component of nearly all terrestrial biomes, distributed throughout the world in almost all habitats ranging from wetlands to deserts, sea level to Himalayan mountains, on all continents except Antarctica. Considering the importance of legumes (pulses), the 68th session of the United Nations General Assembly declared year 2016 as the International Year of Pulses (IYP) to heighten public awareness of the nutritional benefits of pulses as part of sustainable food production. Leguminosae in India is represented by 1297 taxa under 179 genera, of which about 23% are strictly confined to the present Indian political boundary (Sanjappa, 1992). The understanding on the generic and specific delimitations, their circumscriptions etc. depend on various taxonomic features like macro to micro morphological features. Pollen grain being a biological entity subjected to least environmental variations deserves special attention in making taxonomic decisions.

Even though many reports on palynological data on widely distributed and alien species of Indian Leguminosae are available (Vishnu Mittre and Sharma, 1962; Datta and Bagchi, 1969; Tewari and Nair, 1979; Mitra and Mondal, 1982; Kuriakose, 2005; Patil *et al.*, 2012; Deshmukh *et al.*, 2014), only scanty data is available regarding the endemic legumes of India (Murthy, 1992; Tissot *et al.*, 1994). The palynological data of these endemic taxa would certainly have bearing on the taxonomy and classification system followed presently. Hence, the present attempt aims to bring out so far unknown palynological features of 10 endemic Leguminous plants which would certainly help to take right decisions whenever taxonomic problems are encountered related to these plants.

Materials and Methods:-

The polleniferous materials for the present study were procured from freshly collected specimens or from authentic herbarium specimens housed at CAL and MH. Fresh specimens were collected during the flowering season (October – February) and the mature unopened flower buds were fixed in 70% alcohol. The anthers were carefully removed, crushed in distilled water, centrifuged at 1500 rpm and filtered through fine brass mesh. The pollen grains were acetolysed (Erdtman, 1958) and one portion used for the preparation of permanent slides for Light Microscopic studies and the remained portion were subjected to ultra structural analysis under Scanning Electron Microscope (Hitachi, S2400). Pollen descriptions were made followed by Punt *et al.*, (2007) by observing 100 grains of each taxa under LM and SEM. The data with regard to the material used are given at relevant places dealing with the descriptions. Voucher pollen slides are deposited at the Centre for Medicinal Plants Research (CMPR), Kottakkal and the concerned Pollen Slide Numbers (P.S. No) are provided with each taxon.

Results and Discussion:-

The detailed pollen morphology of 10 species belonging to 10 genera are described below, summarized in Table 1, and illustrated in Figs. 2. A-J.

Crotalaria beddomeana:- Thoth. & Ansari, Bull. Bot. Surv. India 20: 180. 1979; Sanjappa, Legumes Ind. 117. 1992; Ansari, Crotalaria India 77. 2008. *Crotalaria lanata* Bedd., Madras J. Lit. Sci. Ser. 2. 19: 178. 1858, non Thunb. 1796. (Fig. 1.A)

Erect shrubs, 1–2.5 m high; Stipules semi-lunar, auriculate, persistent. Leaves simple, 12–17 × 7–7.5 cm, elliptic, rounded at apex. Racemes 17–25 cm long, terminal, lax. Flowers 3 cm long, yellow. Pods 5–6 × 2–2.5 cm, much inflated, glabrous, 12–14 -seeded.

Flowering and fruiting:- October – January.

Habitat:- Open hill slopes at 1200 – 1800 m elevation.

Distribution:- Endemic to Southern Western Ghats (Tamil Nadu & Kerala).

Pollen 3:- zonocolporate; ora lalongate (2.8 × 5.5 μm); colpus membrane faintly perforated; prolate-spheroidal in equatorial view and triangular with convex sides in polar view; average grain size 28.05 × 25.38 μm (27.0 –29.7 × 24.35–27.05 μm); exine 1.65 μm thick, ectexine thinner than endexine, surface granulate (Fig. 2.A).

Source of pollen material:- Kerala, Idukki Dist., Munnar, 20 October 2006, S.V. Predeep & Anoop P.B. 20208; Pollen Slide No. 00276 (CMPR).

Indigofera uniflora:- Buch.-Ham. ex Roxb., Fl. Ind. 3: 374. 1832; Hook. f., Fl. Brit. India 2: 94. 1876; Gamble, Fl. Pres. Madras 309(218). 1918; Sanjappa, Legumes Ind. 198. 1992 and Fasc. Fl. Ind. 21: 152. 1995. (Fig. 1.B)

Prostrate herbs; branches slender. Stipules narrowly triangular. Leaves pinnately or rarely digitately 3–7-foliolate, subsessile; leaflets opposite, 5–8 × 1–2.5 mm, linear-oblongate, obtuse-subacute at apex, cuneate at base. Flowers 3.5 mm long, pink, solitary, axillary. Pods 10– 12 × 2– 3 mm, straight, subcylindrical, apiculate, glabrescent, 3–7 -seeded.

Flowering and fruiting:- October – January.

Habitat:- Open areas in sandy beaches and plains from sea level to 700 m elevation.

Distribution:- Endemic to South India (Andhra Pradesh, Karnataka, Tamil Nadu & Kerala)

Pollen 3:- zonocolporate; ora lalongate (3.5 × 6.95 μm), colpus membrane smooth; sub–prolate in equatorial view and triangular in polar view; average grain size 29.6 × 28.5 μm (28.65–36.8 × 28.2–37.0 μm); exine 2.55 μm thick, ectexine thinner than endexine, surface foveolate (Fig. 2.B).

Source of pollen material:— Kerala, Palakkad Dist., Pattamby, 28 November 2008, S.V. Predeep & Anoop P.B. 20943; P.S. No. 266 (CMPR)

Smithia venkoborowii:- Gamble, Bull. Misc. Inform. Kew 1919: 223. 1919 & Fl. Pres. Madras 330(233). 1918; Sanjappa, Legumes Ind. 248. 1992. (Fig. 1.C)

Erect subshrubs, 30–125 cm high; stem densely bristly. Leaves 3–6 cm long; leaflets 3–4(-5) pairs, sessile, 1.2–2.8 × 0.4–0.8 cm long, oblong, obtuse–retuse at apex, oblique at base, glabrous. Flowers 1.2 cm long, yellow, in axillary subcapitate heads. Lomentum almost included, joints folded back within the calyx, 4–6-jointed.

Flowering and fruiting:- October – January.

Habitat:- Open grasslands and moist hill slopes at 1000–1300 m elevation.

Distribution:- Endemic to South India (Kerala)

Pollen 3:- zonocolpate; colpus spindle shaped, membrane granulose; prolate–spheroidal in equatorial view and triangular with convex sides in polar view; average grain size 17.55 × 16.2 μm (16.2–18.9 × 13.5–18.9 μm); exine 1.05 μm thick, ectexine is thicker than endexine, surface reticulate (**Fig. 2.C**).

Source of pollen material:— Kerala, Idukki Dist., Muringapuzha, 01 December 2007, *Anoop P.B. 20717*; P.S. No. 233 (CMPR).

Sophora wightii:- Baker in Hook. f., Fl. Brit. India 2: 250. 1878; Gamble, Fl. Pres. Madras 289(274). 1918; Sanjappa, Legumes Ind. 250. 1992. *Sophora heptaphylla* sensu Wight, Ic. t. 115. 1846, non L. 1753. (**Fig. 1.D**)

Small trees. Leaves 15–22 cm long including; leaflets 8–15, subopposite–alternate or occasionally opposite, 5–8.5 × 1.8–2.5 cm, ovate–elliptic or obovate, acuminate at apex, obtuse at base. Racemes 15–25 cm long, terminal and axillary. Flowers 1.5–1.7 cm long, yellow. Pods 8–11 × 0.8–1 cm, constricted between seeds, reticulate, pubescent, 2–4-seeded.

Flowering & Fruiting:- November – April.

Habitat:- Margins of shola forests at 1400 – 2000 m elevation.

Distribution:- Endemic to Western Ghats (Maharashtra, Karnataka, Tamil Nadu & Kerala).

Pollen 3:- zonocolporate; ora lalongate (5.3 × 9.5 μm), colpus membrane smooth; oblate–spheroidal in equatorial view and triangular with slightly convex sides in polar view; average grain size 20.25 × 20.93 μm (18.9–22.95 × 18.9–22.95 μm); exine 3.5 μm thick, surface psilate (**Fig. 2.D**).

Source of pollen material:- Karnataka, Chikmagalur dist., Chikkamagaluru, *Sedgwick 2904* (CAL); P.S.No. 00201 (CMPR).

Hardwickia binata:- Roxb., Pl. Corom. t. 209. 1811; Hook. f., Fl. Brit. India 2: 270. 1878; Gamble, Fl. Pres. Madras 412(292). 1919; Sanjappa, Legumes Ind. 29.1992. (**Fig. 1.E**)

Trees, 20–35 m tall. Leaves stipulate, estipellate, 2-foliolate; leaflets sessile, 2.5–5 × 1.2–3.5 cm, obliquely ovate-oblong or obovate, obtuse-rounded at apex, truncate–cuneate at base, coriaceous. Panicles 6–10 cm long, axillary and terminal. Flowers 8 mm long. Sepals 5, petaloid, greenish–white. Petals 0. Stamens 10, free. Pods 7.5–9 × 1.2–1.4 cm, oblong–elliptic, strap-shaped, compressed, glabrous, brown, 1-seeded.

Flowering and fruiting:- December – June.

Habitat:- Dry deciduous forests.

Distribution:- Endemic to India (Uttar Pradesh, Rajasthan, Bihar, Central and Peninsular India)

Pollen 3:- Pantoporate; ora circular (5.5 μm diameter), membrane granulose; spheroidal in equatorial view and broadly hexagonal in polar view; average grain size 46.27 × 45.85 μm (38.85–49.55 × 37.05–49.25 μm); exine 5.05 μm thick, ectexine thicker than endexine, surface reticulate (**Fig. 2.E**).

Source of pollen material:— Kerala, Idukki Dist., Chinnar WLS, 22 March 2006, *S.V. Predeep & Anoop P.B. 20205*; P.S. No. 288 (CMPR).

Humboldtia sanjappae:- Sasidh. et Sujanalpal, Rheedia 17: 21–23. 2007; Anoop *et al.*, Int. J. Pl. An. Env. Sciences 6(2): 90. 2016. (**Fig. 1.F**)

Large trees, 15–30 m tall. Stipules 1 × 0.5 cm, obliquely ovate, appendages absent. Leaves c. 30 cm long; leaflets 2–4, 12–20 × 5.5–7 cm, tender leaflets reddish, drooping, elliptic, obtusely acuminate at apex, obtuse-cuneate at base, glabrous above and below. Racemes 6–12 cm long, axillary as well as cauliflorous. Flowers 2 cm long, white. Calyx lobes 4. Petals–5, white. Pods 14–17.5 × 3.5–4.2 cm, obliquely oblong, compressed, beaked, glabrous, upper suture thickened, 1–2-seeded.

Flowering and fruiting:- December – April.

Habitat:- Evergreen forests

Distribution:- Endemic to Southern Western Ghats (Kerala).

Pollen 3:- zonocolporate; ora lalongate ($10.5 \times 5.8 \mu\text{m}$); colpi long, membrane faintly rugulate; oblate-spheroidal in equatorial view and broadly hexagonal in polar view; average grain size $49.10 \times 51.18 \mu\text{m}$ ($48.35\text{--}56.64 \times 47.85\text{--}55.35 \mu\text{m}$); exine $3.65 \mu\text{m}$ thick, ectexine as thick as endexine, surface rugulate (**Fig. 2.F**) .

Source of pollen material:- Kerala, Idukki Dist., Neryamangalam, 16 January 2008, *S.V. Predeep & Anoop P.B.* 20826; P.S. No. 209 (CMPR).

Kingiodendron pinnatum:- (Roxb. ex DC.) Harms in Engl. & Prantl, Nat. Pflanzenf. 1(1): 194. 1897; Gamble, Fl. Pres. Madras 412(292). 1919; Sanjappa, Legumes Ind. 32.1992. *Hardwickia pinnata* Roxb. ex DC., Prodr. 2: 487. 1825; Hook. f., Fl. Brit. India 2: 270. 1878. (**Fig. 1.G**)

Large evergreen trees, 25–35 m tall. Leaves, imparipinnate, 16–28 cm long; leaflets 5–7, alternate, 8–15 x 3–5.5 cm, ovate-oblong, acuminate at apex, obtuse and slightly oblique at base. Flowers 3 mm long, white, in axillary and terminal paniced spikes. Sepals 5. Petals 0. Pods 4 x 2–2.5 cm, ovate-ellipsoid, woody, turgid, apically winged, 1-seeded.

Flowering and fruiting:- January – August.

Habitat:- Evergreen forests.

Distribution:- Endemic to Southern Western Ghats (Karnataka, Tamil Nadu and Kerala).

Pollen 3:- zonocolporate; ora lalongate ($3.4 \times 7.8 \mu\text{m}$); colpus membrane granulose; sub-prolate in equatorial view and broadly hexagonal in polar view; average grain size $26.27 \times 21.82 \mu\text{m}$ ($21.85\text{--}28.55 \times 19.85\text{--}24.05 \mu\text{m}$); exine $4.35 \mu\text{m}$ thick, ectexine as thick as endexine, surface scabrate (**Fig. 2.G**) .

Source of pollen material:- Kerala, Kollam Dist., Rosemala, 20 January 1994, *Sasidharan* 10812 (CAL); P.S. No. 99 (CMPR).

Moullava spicata:- (Dalz.) Nicols. in Manilal, Bot. Hist. Hort. Malab. 181. 1981; Sanjappa, Legumes Ind. 33.1992. *Caesalpinia spicata* Dalz., Hook.'s J. Bot. Kew Gard. Misc. 3: 90. 1851. *Wagatea spicata* (Dalz.) Wight, Ic. t. 1995. 1853; Hook. f., Fl. Brit. India 2: 261. 1878; Gamble, Fl. Pres. Madras 397(281). 1919. (**Fig. 1.H**)

Armed lianas. Leaves bipinnate, 35–48 cm long: pinnae 3–5 pairs; leaflets 4–7 pairs, 2.5–6 x 1.2–2.5 cm, ovate-elliptic, obtuse-subacute at apex, obtuse and slightly oblique at base. Racemes 30–50 cm long, terminal, simple and paniced, spicate. Flowers 1.2 cm long, golden-yellow. Calyx lobes 5. Petals 5. Pods 5–6.5 x 1.3–1.5 cm, linear-oblong, subtorulose, 3–5–6–seeded.

Flowering and fruiting:- December – May.

Habitat:- Moist deciduous forests, in open areas.

Distribution:- Endemic to Western Ghats (Maharashtra, Karnataka, Tamil Nadu and Kerala)

Pollen 3:- zonocolporate; ora lalongate ($4.8 \times 9.6 \mu\text{m}$); colpus membrane verrucate; oblate-spheroidal in equatorial view and broadly circular in polar view; average grain size $31.17 \times 34.42 \mu\text{m}$ ($27\text{--}35.1 \times 32.4\text{--}35.1 \mu\text{m}$); exine $3.65 \mu\text{m}$ thick, ectexine thicker than endexine, surface finely punctate (**Fig. 2.H**) .

Source of pollen material:- Kerala, Kozhikode Dist., Kakkayam, 29 January 2007, *Udayan P.S. & Anoop P.B.* 20609 & 20823; P.S. No. 89 (CMPR).

Pterolobium hexapetalum:- (Roth) Sant. & Wagh, Bull. Bot. Surv. India 5: 108. 1964; Sanjappa, Legumes Ind. 34. 1992. *Reichardia hexapetala* Roth, Nov. Pl. Sp. 210. 1821. *Caesalpinia lacerans* Roxb., Fl. Ind. 2: 367. 1832. *Pterolobium indicum* Rich., Fl. Abyss. 1: 247. 1847; Hook. f., Fl. Brit. India 2: 259. 1878; Gamble, Fl. Pres. Madras 395(280). 1919. *Pterolobium lacerans* Wall. ex Wight & Arn., Prodr. 283. 1834. (**Fig. 1. I**)

Profusely armed stragglers. Leaves bipinnate; pinnae 4–6 pairs, 3–4 cm long; leaflets 5–9 pairs, opposite, 8–12 x 4–6 mm, ovate-oblong, retuse at apex, unequal at base. Racemes 10–12 cm long, terminal and axillary, simple or branched. Flowers 1.5 cm across, white. Calyx lobes 5, petaloid. Petals 5. Pods samaroid, 3.5–4 x 1–1.2 cm, obliquely oblong, compressed, apically winged.

Flowering and fruiting:- August – December.

Habitat:- Dry deciduous forests.

Distribution:- Endemic to India (Uttar Pradesh, W. Bengal, Andhra Pradesh, Karnataka, Tamil Nadu and Kerala)

Pollen 3:- zonocolporate; ora lalongate ($3.2 \times 6.5 \mu\text{m}$); colpus membrane verrucate; sub-oblate in equatorial view and broadly circular in polar view; average grain size $22.27 \times 26.32 \mu\text{m}$ ($21.6\text{--}24.3 \times 24.3\text{--}27 \mu\text{m}$); exine $2.75 \mu\text{m}$ thick, ectexine as thick as endexine, surface reticulate (**Fig. 2. I**).

Source of pollen material:- Kerala, Idukki Dist., Chinnar WLS, 21 October 2006, *S.V. Predeep & Anoop P.B.* 20248; P.S.No. 0011 (CMPR).

Senna intermedia:- (Sharma et al.) Singh, J. Econ. Taxon. Bot. 16: 600. 1992 & Indian Cassiinae 144. 2001. *Cassia intermedia* Sharma et al., Proc. Indian Acad. Sci. (Pl. Sci.) 80B: 301. 1974; Sanjappa, Legumes Ind. 16. 1992. (**Fig. 1.J**)

Shrubs, 1.5–2 m tall. Leaves 8–18 cm long; leaflets 3–5 pairs, 2–7.5 \times 1.5–2.3 cm, distal pairs larger, ovate–elliptic, acute–shortly acuminate at apex, slightly unequal and obtuse at base. Racemes 8–12 cm long, terminal. Flowers 3.5 cm across, yellow. Pods 5–6 \times 0.5–0.6 cm, oblong, compressed, straight, occasionally constricted between seeds, densely hairy.

Flowering and fruiting:- August – January.

Habitat:- Wastelands and degraded forest areas.

Distribution:- Endemic to Southern Western Ghats (Tamil Nadu and Kerala).

Pollen 3:- zonocolporate; ora lolongate ($5.2 \times 2.8 \mu\text{m}$); colpus membrane granulose; oblate–spheroidal in equatorial view and broadly hexagonal in polar view; average grain size $26.27 \times 28.32 \mu\text{m}$ ($21.2\text{--}34.3 \times 21.93\text{--}33.6 \mu\text{m}$); exine $4.05 \mu\text{m}$ thick, ectexine as thick as endexine, surface finely reticulate (**Fig. 2.J**) .

Source of pollen material:- Kerala, Pathanamthitta Dist., Pampa Dam, 21 November 2008, *Anoop P.B.* 20880; P.S. No. 0032 (CMPR).

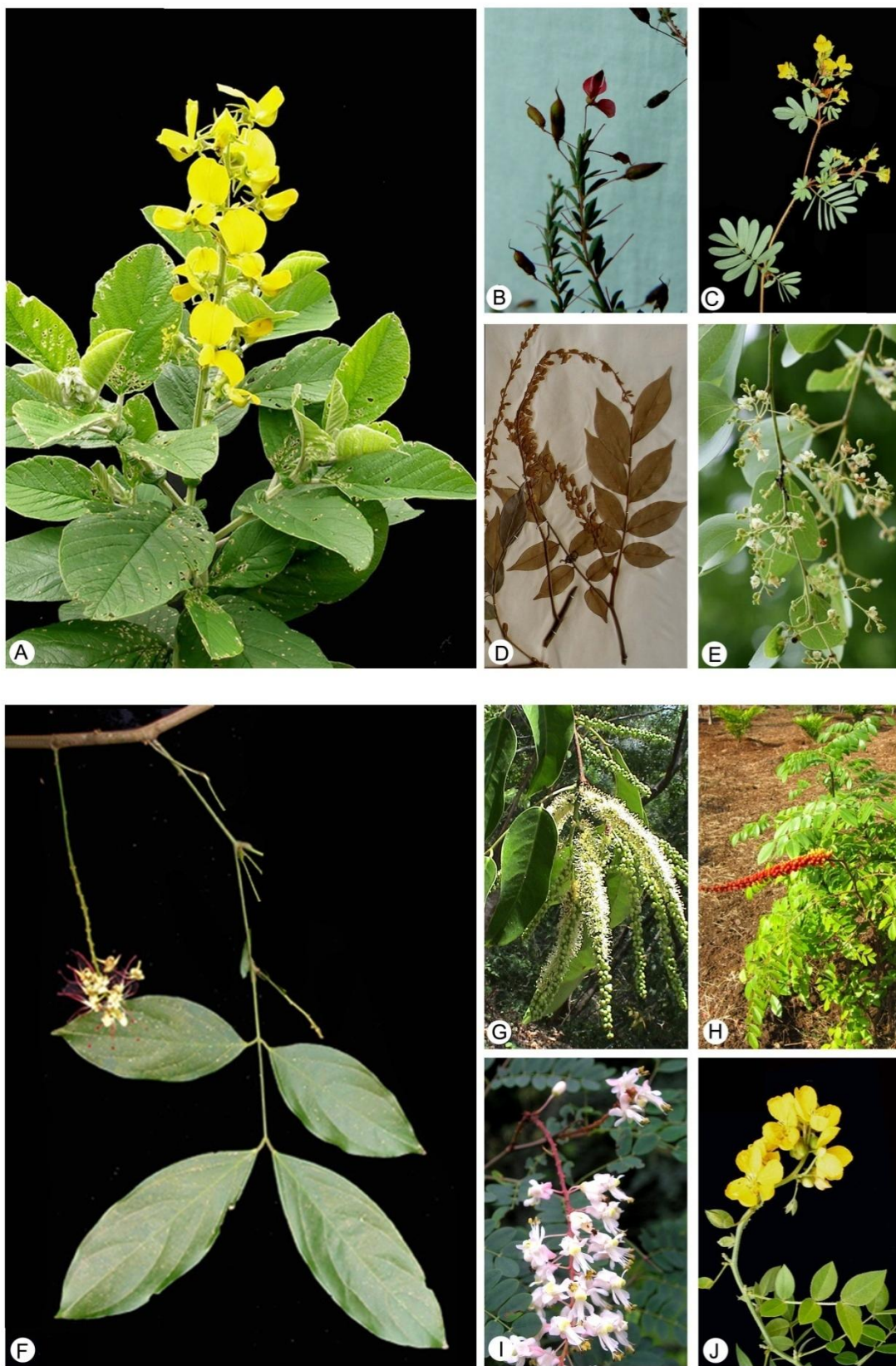


Fig.1:- A. *Crotalaria beddomeana*; B. *Indigofera uniflora*; C. *Smithia venkobarrowii*; D. *Sophora wightii*; E. *Hardwickia binata*; F. *Humboldtia sanjappae*; G. *Kingiodendron pinnatum*; H. *Moullava spicata*; I. *Pterolobium hexapetalum*; J. *Senna intermedia*

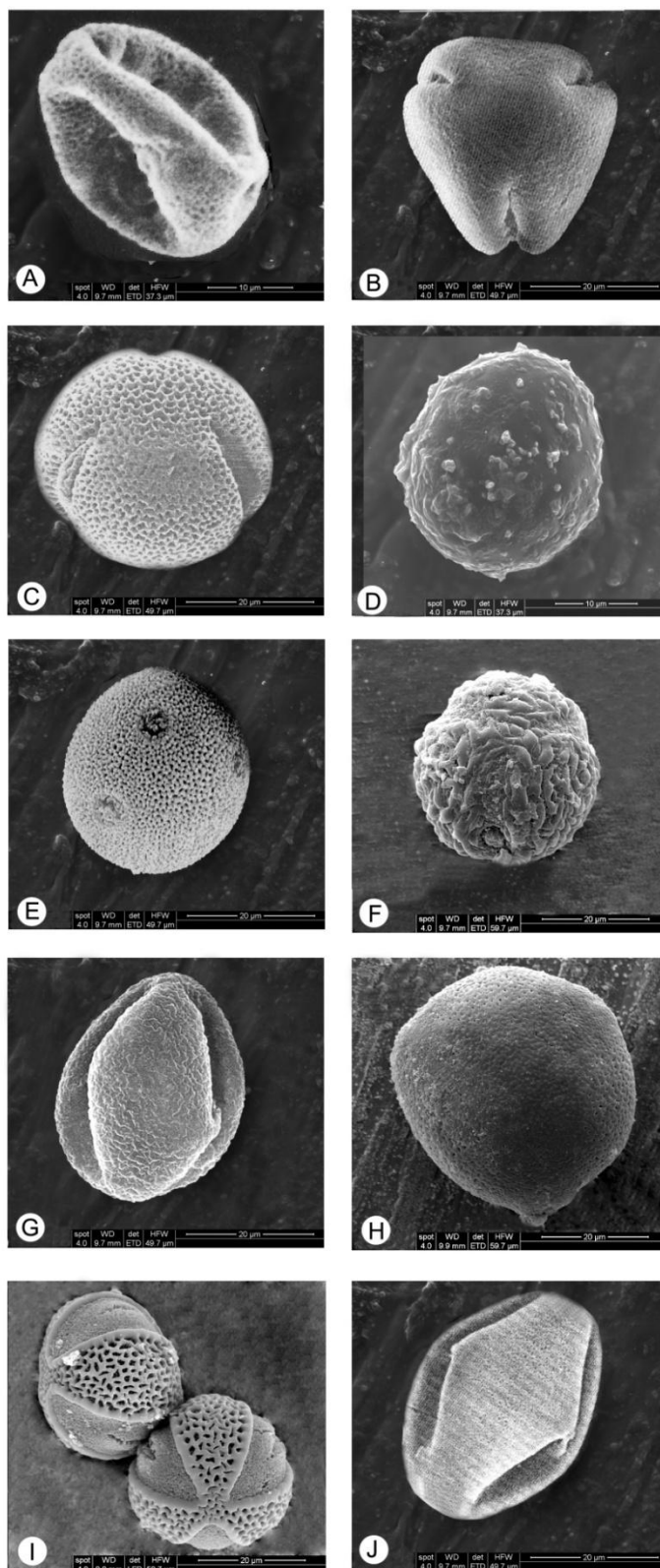


Fig.2:- Scanning Electron Micrographs of pollen grains (4500 X): A. *Crotalaria beddomeana*; B. *Indigofera uniflora*; C. *Smithia venkobarrowii*; D. *Sophora wightii*; E. *Hardwickia binata*; F. *Humboldtia sanjappae*; G. *Kingiodendron pinnatum*; H. *Moullava spicata*; I. *Pterolobium hexapetalum*; J. *Senna intermedia*.

Key to the species:-

Subfamily: Papilionoideae	
1a. Pollen 3-zonocolporate.....	2
1b. Pollen 3-zonocolpate	<i>Smithia venkobarrowii</i>
2a. Exine thickness < 2 µm	<i>Crotalaria beddomeana</i>
2b. Exine thickness > 2 µm	3
3a. Exine ornamentation foveolate	<i>Indigofera uniflora</i>
3b. Exine ornamentation psilate	<i>Sophora wightii</i>
Subfamily: Caesalpinioideae	
1a. Pollen tricolporate	2
1b. Pollen pantoporate	<i>Hardwickia binata</i>
2a. Ora lalongate	3
2b. Ora lolongate	4
3a. Pollen shape sub-oblate; colpus membrane verrucate	5
3b. Pollen shape oblate-spheroidal; colpus membrane granulate	<i>Kingiodendron pinnatum</i>
4a. Exine surface reticulate	<i>Senna intermedia</i>
4b. Exine surface rugulate	<i>Humboldtia sanjappae</i>
5a. Exine surface reticulate	<i>Pterolobium hexapetalum</i>
5b. Exine surface punctate	<i>Moullava spicata</i>

A considerable variation in pollen morphology especially in apertural characters and exine patterns was observed in the pollen grains of the 10 legume species in the present study. The pollen grains are generally 3-zonocolporate, rarely 3-zonocolpate (*Smithia venkobarrowii*) or pantoporate (*Hardwickia binata*). The ora are lalongate or lolongate except in *Hardwickia binata*. The shapes of the pollen grains are commonly sub-oblate to oblate-spheroidal, spheroidal or prolate-spheroidal. Average pollen size ranges from (17.55 × 16.2 µm) to (49.10 × 51.18 µm). Exine thickness varies from 1.05 µm to 5.05 µm and the exine ornamentation shows highest variation among genera, from psilate to foveolate, granulate, rugulate, reticulate, scabrate or verrucate. *Smithia venkobarrowii* presents the primitive aperture type, i.e. tricolpate type while the rest shows advance colporate type apertures.

Tewari & Nair (1979) reported colporoidate pollen grains in some Indian *Indigofera* sp. But the pollen grains of *Indigofera uniflora* in the present study is clearly colporate, shows distinct ora (3.5 × 6.9 µm).

Pantoporate pollen of *Hardwickia* Roxb. is a unique type in Caesalpinioideae, only reported from an African genus *Colophospermum* Kirk ex J. Leonard and this condition is said to be a method of increasing contact between cuticular-dissolving enzymes of the intine and the stigmatic surface (Graham et al., 1980).

The pollen grains of *Pterolobium hexapetalum* are characterized by a broad, deeply reticulate margo surrounding a weakly developed, diffused-margin colpus and a well developed pore, which are the prominent pollen features of the tribe Caesalpinieae (Graham & Barker, 1981).

Acknowledgments:-

The authors are grateful to the Director, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram for providing SEM facilities; authorities of Kerala State Forest department for the help given during field study; Dr. N. Sasidharan (KFRI, Peechi) and Mr. Reji Yohannan (SN College, Kollam) for few images. We are also thankful to the Principal, SVR NSS College, Vazhoor for the facilities provided and the first author is thankful to the authorities of the Centre for Medicinal Plants Research (CMPR), Arya Vaidya Sala, Kottakkal, Kerala for the support given.

Table 1:- Pollen grain characteristics of 10 Indian endemic legumes

Name of Plant	Pollen type	Ora		Colpus membrane	Pollen shape	Average pollen size (μm)	Exine	
		Shape	Size (μm)				Thickness(μm)	Ornamentation
Subfamily Papilionoideae								
<i>Crotalaria beddomeana</i>	3-zonocolporate	Lalongate	2.8 × 5.5	Faintly perforated	Prol.-Spher.	28.05 × 25.38	1.65	Granulate
<i>Indigofera uniflora</i>	3-zonocolporate	Lalongate	3.5 × 6.9	Smooth	Sub-prolate	29.6 × 28.5	2.55	Foveolate
<i>Smithia venkobarrowii</i>	3-zonocolporate	-	-	Granulose	Prol.-Spher.	17.55 × 16.2	1.05	Reticulate
<i>Sophora wightii</i>	3-zonocolporate	Lalongate	5.3 × 9.5	Smooth	Obl.-Spher.	20.25 × 20.93	3.5	Psilate
Subfamily Caesalpinioideae								
<i>Hardwickia binata</i>	Pantoporate	Circular	5.5	Granulose	Spheroidal	46.27 × 45.85	5.05	Reticulate
<i>Humboldtia sanjappae</i>	3-zonocolporate	Lolongate	10.5 × 5.8	Rugulose	Obl.-Spher.	49.10 × 51.18	3.65	Rugulate
<i>Kingiodendron pinnatum</i>	3-zonocolporate	Lalongate	3.4 × 7.8	Granulose	Sub-prolate	26.27 × 21.82	4.35	Scabrate
<i>Moullava spicata</i>	3-zonocolporate	Lalongate	4.8 × 9.6	Verrucate	Obl.-Spher.	31.17 × 34.42	3.65	Punctate
<i>Pterolobium hexapetalum</i>	3-zonocolporate	Lalongate	3.2 × 6.5	Verrucate	Sub-oblate	22.27 × 26.32	2.75	Reticulate
<i>Senna intermedia</i>	3-zonocolporate	Lolongate	5.2 × 2.8	Granulose	Obl.-Spher.	26.27 × 28.32	4.05	Reticulate

References:-

- Datta, R.M. and Bagchi, S. (1969). Pollen morphology of *Crotalaria* L. *Castanea* 34(1): 66-76.
- Deshmukh, S.A. Barge, S.H. and Gaikwad, D.K. (2014). Palyno-Morphometric studies in some *Cassia* L. species from Maharashtra. *Ind. J. Pl. Sci.* 3(3): 71-78.
- Erdtman, G. (1958). Pollen Morphology and Plant Taxonomy. Angiosperms. Chron. Bot. Co., Waltham, Massachusetts.
- Graham, A. (1980). Unique Pollen types in the Caesalpinioideae (Leguminosae). *Grana* 19(2): 81.
- Graham, A. and Barker, G. (1981). Palynology and Tribal classification in the Caesalpinioideae. In: R.M. Polhill and P.H. Raven (Eds.). *Advances in Legume systematic Part 2*. Royal Botanic Garden, Kew, pp 804.
- Krishna Mitra and Madhusudan Mondal (1982). Pollen morphology of Exstipellate and Stipellate Hedysareae (Leguminosae). *Proc. Ind. Nat. Sci. Acad.* 6: 755-769.
- Kuriakose, M.E. (2005). Pollen morphology of the tribe Dalbergiae from S. India. *J. Palynol.* 41: 59-68.
- Lewis, G., Schrire, B., MacKinder, B. & Lock, M. (Ed.) (2005). *Legumes of the World*. Royal Botanic Gardens, Kew.
- Murthy, G.V.S. (1992). Pollen morphology of the genus *Humboldtia* Vahl (Caesalpinioideae). *J. Palynol.* 28: 57-62.
- Nair, P.K.K. and Sharma, B.D. (1962). Pollen Grains of Indian Plants. iv. Leguminosae (part 1). *Bull. Nat. Bot. Gard.* 65: 1-37
- Patil, R.P., Kare, M.A. and Pokle, D.S. (2012). Study of pollen morphology in Genus *Alysicarpus* Desv. *DAV Int. J. Sci.* 1(1): 39-41.
- Punt, W., Hoën, P.P., Blackmore, S., Nilsson, S. & A. Le Thomas (2007). Glossary of pollen and spore terminology. *Rev. Palaeobot. Palyn.* 143: 1-81.
- Sanjappa, M. (1992). *Legumes of India*. Bishen Singh Mahendra Pal Singh, Dehra Dun.
- Tewari, R.B. and Nair, P.K.K. (1979). Pollen morphology of some Indian Papilionaceae. *J. Palynol.* 15(2): 49-73.
- Tissot, C., Chikhi, H. and Nair, T.S. (1994). Pollen of wet evergreen forests of the Western Ghats of India. French Institute, Pondichery, pp 30-31.
- Vishnu Mittre and Sharma, B.D. (1962). Studies of Indian Pollen grains. I. Leguminosae. *Pollen et Spores.* 4(1): 5-45