



Palynological studies of some species of *Boraginaceae* Juss. in Karnataka

Sakshi Turamari, Shreyas Betageri*, Vanaja G Patgar, K Kotresha

Department of Botany, Taxonomy and Floristic Laboratory, Karnatak University's, Karnataka Science College, Dharwad, Karnataka, India

Abstract

Palynology is the evidences in taxonomy to study advanced differentiation between species. *Boraginaceae* Juss. reports 154 genera and around 1800 species across the globe. 7 genera and 12 species of *Boraginaceae* family, in that dominant genera are *Heliotropium* and *Trichodesma* contain 3 species during our survey. Palynological study of *Boraginaceae* family exhibit various type of shapes includes Prolate spheroidal, suboblate, prolate. Apertures are highly variable and include types such as tricolpate, tricolporate, trisynocolporate, hexacolporate and hexatricolporate. Surface of pollen is smooth, reticulate, ruff, spiny, dotted or pitted in all different species.

Keywords: *Cyanoglossum*, *Euploca*, *Heliotropium*, Pollen morphology, Surface texture. *Trichodesma*

Introduction

Boraginaceae is a group of flowering plants in the larger group called Lamiidae. It includes about 154 genera and around 1800 species (POWO, 2025) [16]. Earlier, before molecular data was available, many scientists followed this classification. However, some researchers believed that some of these subfamilies should be treated as separate families. Chadeaud & Emberger (1960) grouped *Boraginaceae*, *Hoplostigmataceae*, *Hydrophyllaceae*, and *Lennoaceae* together in the order Tubiflorales. Takhtajan (1980) placed them in a suborder called Boraginineae (Luebert, *et al.*, 2016) [14]. Flora of Karnataka A Checklist, Vol. 2: Gymnosperms & Angiosperms have reported 196 families contain 4853 species under 1543 genera among 9 genera (*Adelocaryum*, *Coldenia*, *Cordia*, *Cynoglossum*, *Ehretia*, *Heliotropium*, *Rotula*, *Tournefortia*, *Trichodesma*) and 41 species (*A.coelestinum*, *A.malabaricum*, *C.procumbens*, *C.alba*, *C.dichotoma*, *C.domestica*, *C.macleodii*, *C.monoica*, *C.myxa*, *C.nevillii*, *C.perrottetii*, *C.sebestena*, *C.sinensis*, *C.ritchiei*, *C.wallichii*, *C.zeylanicum*, *E.acuminata*, *E.laevis*, *E.microphylla*, *E.wightiana*, *H.amplexicaule*, *H.arborescens*, *H.bracteatum*, *H.cornutum*, *H.indicum*, *H.keralense*, *H.marifolium*, *H.pycnophyllum*, *H.ramosissimum*, *H.rariflorum*, *H.scabrum*, *H.strigosum*, *H.subulatum*, *H.suipinum*, *H.zeylanicum*, *R.aquatica*, *T.reticosa*, *T.inaequale*, *T.indicum*, *T.amplexicuale*, *T.zeylanicum*) belongs to *Boraginaceae* family (Sringswara & Sanjappa, 2019).

The palynological study of *Boraginaceae* species focuses on establishing diagnostic features for identifying and classifying taxa through detailed examination of pollen grain morphology. Pollen grains are mostly monads, minute to small, with polar axis diameter ranging from 6.0 to 36.0 μm and equatorial diameter from 4.0 to 28.0 μm . Shapes are highly variable, including prolate, subprolate, spheroidal, and oblate spheroidal. (Attar, *et al.*, 2018) [1]. Pollen grains are monads, generally minute to small-sized (6.0 \times 4.0 μm to 36.0 \times 25.0 μm). Mostly prolate or subprolate, with shapes ranging from oblate-spheroidal to perprolate (P/E ratio: 0.93–2.2). Predominantly isopolar, with some heteropolar or subisopolar grains in specific genera. (Kamel, *et al.*, 2018) [10]. Pollen morphology of selected taxa of

Ehretiaceae from Western Ghats, India reported *Ehretia pubescens* with tri-zonocolporate and heterocolporate pollen grains and *Cormona retusa* with tricolpate pollen grain without the pseudocolpi. Both genera have foveolate tectum. Palynological data indicate that these two naturalized taxa (Mary & Gopal, 2018) [15].

Most grains are isopolar (symmetrical), but heteropolar (asymmetrical) and subisopolar grains occur in some taxa, especially in *Euploca* and *Heliotropium*. Two main apertures are observed, heteroaperturate and homoaperturate. Colpus length is described as terminal (0.8–0.9 times polar axis), subterminal (0.7–0.8), short (0.5–0.7), or very short (<0.5). Shape is usually lolongate or lalongate, rarely circular, sometimes operculate or protruded. Surface sculpture varies-psilate, perforate, rugulate, fossulate, micro-echinate, or reticulate to micro-reticulate. (Kumar, *et al.*, 2020) [12]. Palynological diversity of highly medicinal rare, endangered, and threatened plants from Western Himalaya, India threatened plants from Western Himalaya, India reports *Arnebia benthamii* (Wall. ex G. Don) I.M. Johnst. (*Boraginaceae*) and other 31 plant species covering 28 genera, 22 families, and 17 orders of Angiosperms conducted light microscopic analysis of pollen with three species *Heliotropium indicum*, *Trichodesma indicum* and *T. zeylanicum* from 15 localities of Bihar (Kumar, *et al.*, 2022) [13].

Recently in 2025 recorded seed morphometry (Using scanning electron microscope) of different families like Orchidaceae with 104 species (Betageri and Kotresha, 2025), Lamiaceae with 10 species of 7 genera (Yukti, *et al.*, 2025) [23] and *Cyperaceae* with 12 species of 6 genera (Desai, *et al.*, 2025) [6, 7]. But recently pollen morphometry has not been reported from Karnataka in 2025.

Material methods

Collection of Species

The plant specimens were collected from different locations of Dharwad district, different seasons were considered for study. The present work is carried out in the year 2024–2025, considering pre-monsoon, monsoon winter and summer. Pre-monsoon include April–June showers. Monsoon includes June–September showers. Winter December to January. Summer includes February–April.

Identification of Species and Updation of Nomenclature

Identification of species using the flora (Cooke, 1906; Gamble, 1928; Saldanha & Nicolson, 1976; Saldanha, 1984 & 1996; Seetharam, *et al.*, 2000; Bhat, 2003; Bhat, 2014; Kotresha & Kambhar, 2016) [3, 4, 5, 8, 11, 17, 18, 19, 20]. Species names were updated as per Royal Botanical garden, Kew (POWO, 2025) [16], and The World Flora Online (WFO) Plant List (WFO, 2025) [22].

Pollen Morphometric Study

Mature anthers are collected in 70 % alcohol in eppendorf tubes with codes for SEM studies. The seeds are shade dried and giving for Scanning Electron Micrographs. The seeds were mounted on carbon stub. Using paint brush seeds are spread without damage. Place the sample into a gold sputtering, using a mini-gold sputter, sputter gold for 30s at ~ 70 m Torr pressure. Remove stub from gold sputtering system. Tan stub is kept under electron microscope to take photography (Betageri & Kotresha, 2024; Deshi, *et al.*, 2025) [2, 6, 7].

Results

Collected and recorded 7 genera and 12 species of *Boraginaceae* family, in that dominant genera are *Heliotropium* and *Trichodesma* contain 3 species during our survey. Palynological study of *Boraginaceae* family exhibit various type of shapes includes Prolate spheroidal, suboblate, prolate. Apertures are highly variable and include types such as tricolpate, tricolporate, trisynocolporate, hexacolporate and hexatricolporate. Surface of pollen is smooth, reticulate, ruff, spiny, dotted or pitted in different species. The diversity in pollen morphology reflects evolutionary adaptations to different environments and pollination strategies (Fig. 1-4 and Table 01).

Coldenia procumbens L.

The pollen grains exhibit a prolate-spheroidal shape prolate-spheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 19.7µm, while average breadth is 17.7µm. And there is presence of Nodes.

Cynoglossum zeylanicum (Sw. ex Lehm.) Thunb. ex Brand

The pollen grains exhibit a prolate-spheroidal shape prolate-spheroidal shape which has a 6-heterocolpate shape. The average length of the pollen grains is 8.011µm, while

average breadth is 2.51µm. And there is no presence of Nodes.

Ehretia laevis Roxb

The pollen grains exhibit a prolate-spheroidal shape prolate-spheroidal shape which has a 6-heterocolpate shape. The average length of the pollen grains is 23.69µm, while average breadth is 15.21µm. And there is presence of Nodes.

Euploca marifolia (J. Koenig ex Retz.) Ancy & P. Javad

The pollen grains exhibit a prolate to prolate-spheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 34.62µm, while average breadth is 30.9µm. And there is presence of Nodes.

Euploca ovalifolia (Forssk.) Diane & Hilger

The pollen grains exhibit a prolate to prolate-spheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 25.03µm, while average breadth is 24.05µm. And there is presence of Nodes.

Heliotropium amplexicaule Vahl

The pollen grains exhibit a prolate to prolate-spheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 29.84µm, while average breadth is 22.92µm. And there is presence of Nodes.

Heliotropium indicum L.

The pollen grains exhibit a hexagonal shape which has a Tricolpate shape. The average length of the pollen grains is 35.29µm, while average breadth is 21.65µm. And there is no presence of Nodes.

Heliotropium supinum L.

The pollen grains exhibit a hexagonal shape which has a Tricolpate shape. The average length of the pollen grains is 30.46µm, while average breadth is 24.54µm. And there is no presence of Nodes.

Trichodesma inaequale Edgew.

The pollen grains exhibit a sub-spheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 20.35µm, while average breadth is 19.44µm. And there is presence of Nodes.

Table 1: Data showing pollen parameters (Length, breadth, Colpi, Nodes, Surface) of some *Boraginaceae* in Karnataka

Scientific name	Length	breadth	L/B	Colpate no.	Nodes	Surface
<i>Coldenia procumbens</i> L.	19.7	17.7	1.11	Tricolpate	Present	Reticulate
<i>Cynoglossum zeylanicum</i> (Sw. ex Lehm.) Thunb. ex Brand	8.011	2.51	3.19	6-heterocolpate	Absent	Smooth
<i>Ehretia laevis</i> Roxb.	23.69	15.21	1.55	6-heterocolpate	Present	Reticulate
<i>Euploca marifolia</i> (J. Koenig ex Retz.) Ancy & P. Javad	34.62	30.9	1.12	Tricolpate	Present	Spiny outgrowths
<i>Euploca ovalifolia</i> (Forssk.) Diane & Hilger	25.03	24.05	1.04	Tricolpate	Present	Rugose
<i>Heliotropium amplexicaule</i> Vahl.	29.84	22.92	1.3	Tricolpate	Present	Smooth
<i>Heliotropium indicum</i> L.	35.29	21.65	1.63	Tricolpate	Absent	Smooth
<i>Heliotropium supinum</i> L.	30.46	24.54	1.24	Tricolpate	Absent	Ruff
<i>Trichodesma inaequale</i> Edgew.	20.35	19.44	1.04	Tricolpate	Present	Dotted
<i>Trichodesma indicum</i> (L.) Sm.	22.07	16.83	1.31	Tricolpate	Present	Dotted
<i>Trichodesma zeylanicum</i> (Burm. f.) R. Br.	18.71	16.07	1.16	Tricolpate	Absent	Dotted

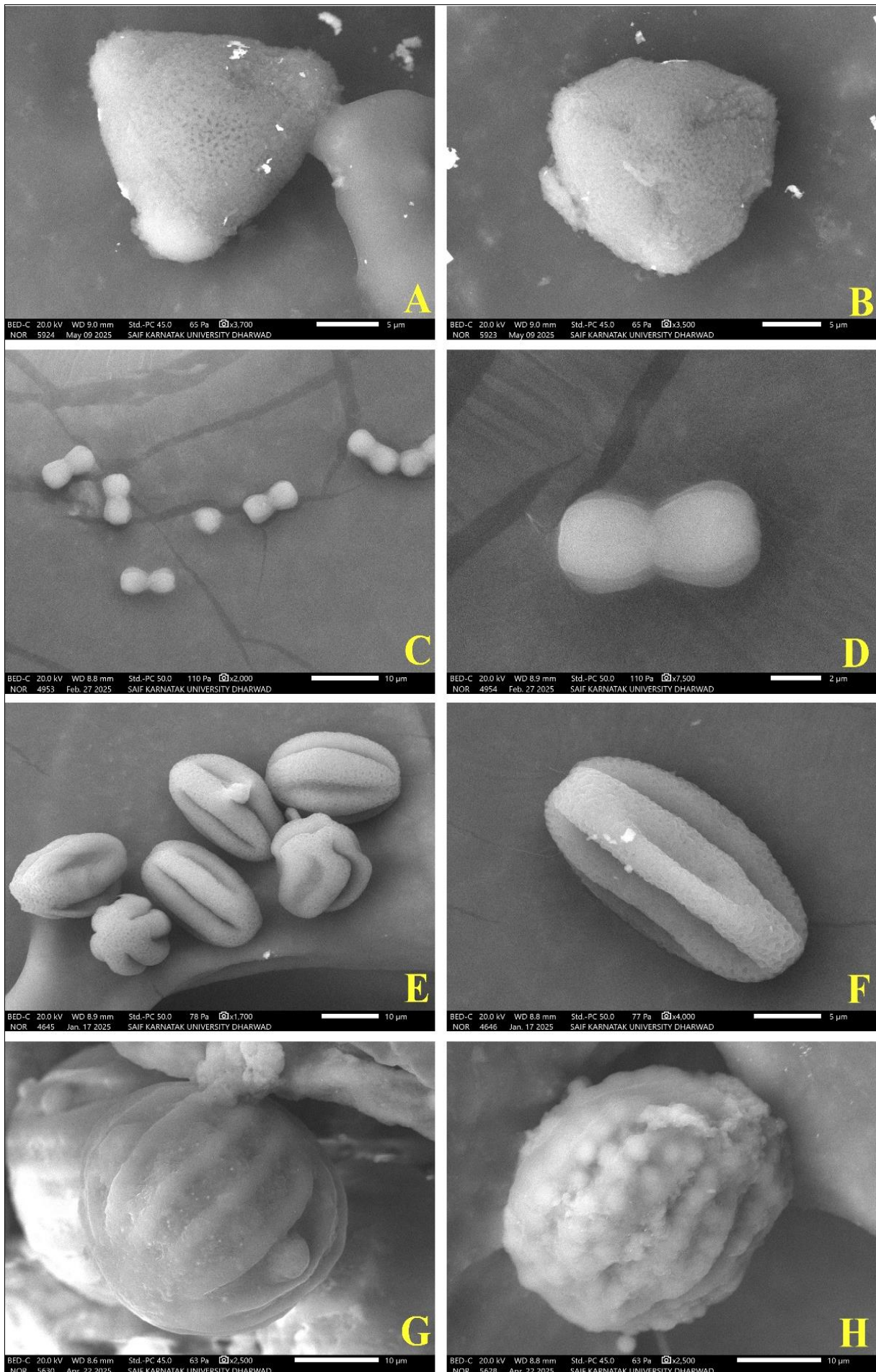


Fig 1: Pollen Morphometry of *Boraginaceae* in Dharwad A. B. *Coldenia procumbens* L.; C. D. *Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex Brand; E. F. *Ehretia laevis* Roxb; G. H. *Euploca marifolia* (J. Koenig ex Retz.) Ancy & P. Javad.

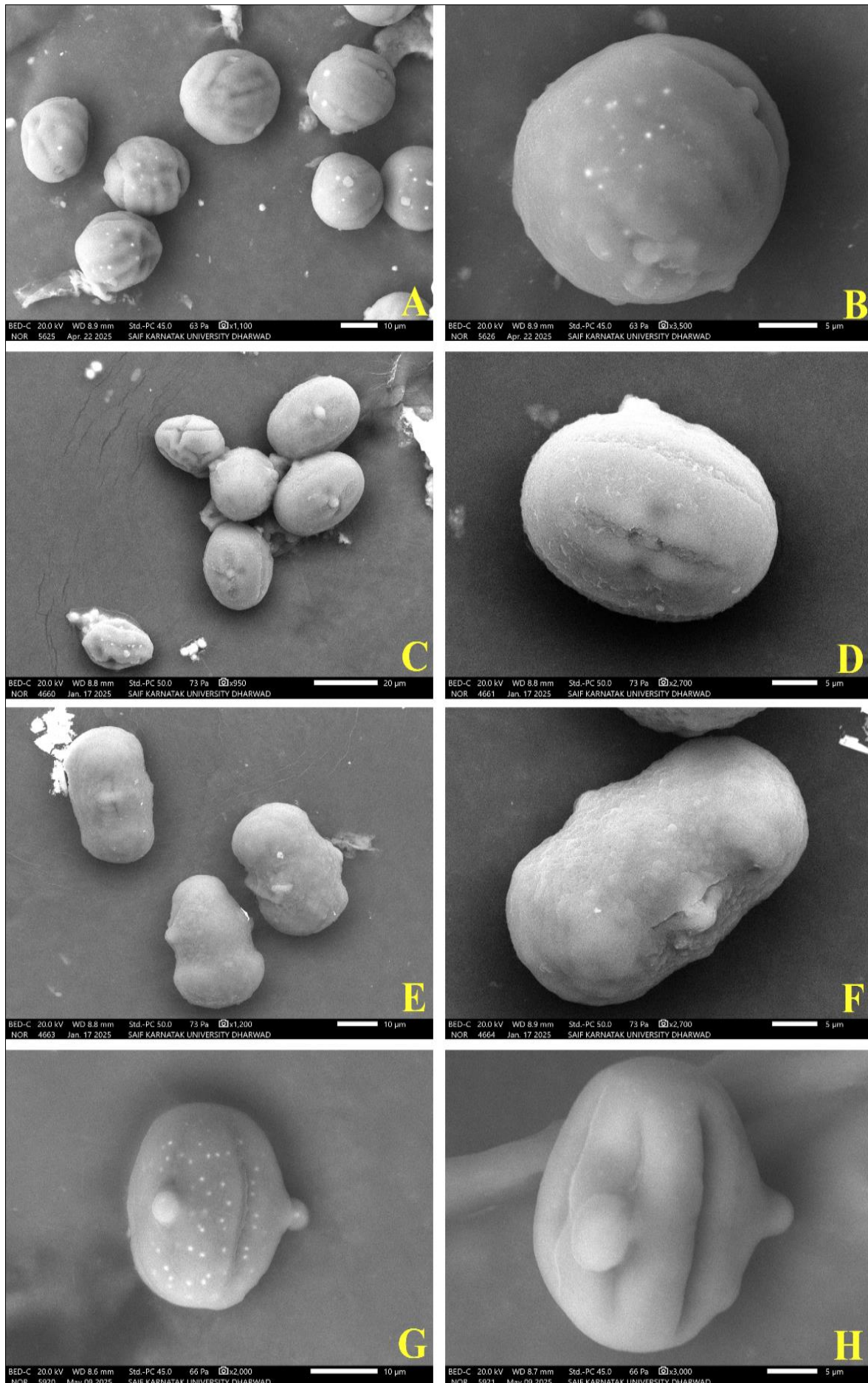


Fig 2: Pollen Morphometry of *Boraginaceae*; A & B. *Euploca ovalifolia* (Forssk.) Diane & Hilger; C & D. *Heliotropium amplexicaule* Vahl; E & F. *Heliotropium indicum* L.; G & H. *Heliotropium supinum* L.

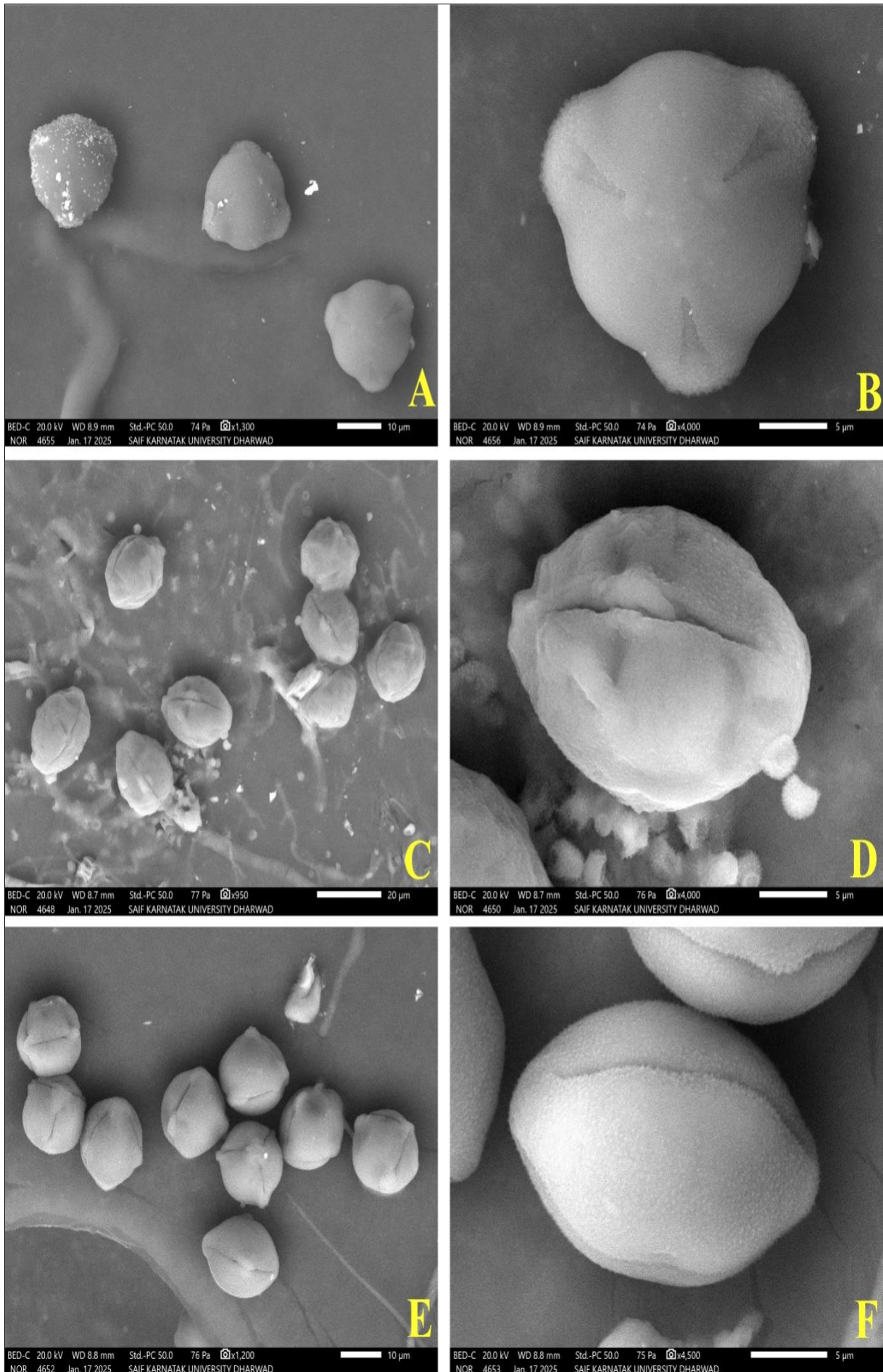


Fig 3: Pollen Morphometry of *Boraginaceae*; A & B. *Trichodesma inaequale* Edgew.; C & D. *Trichodesma indicum* (L.) Sm.; E & F. *Trichodesma zeylanicum* (Burm. f.) R. Br.

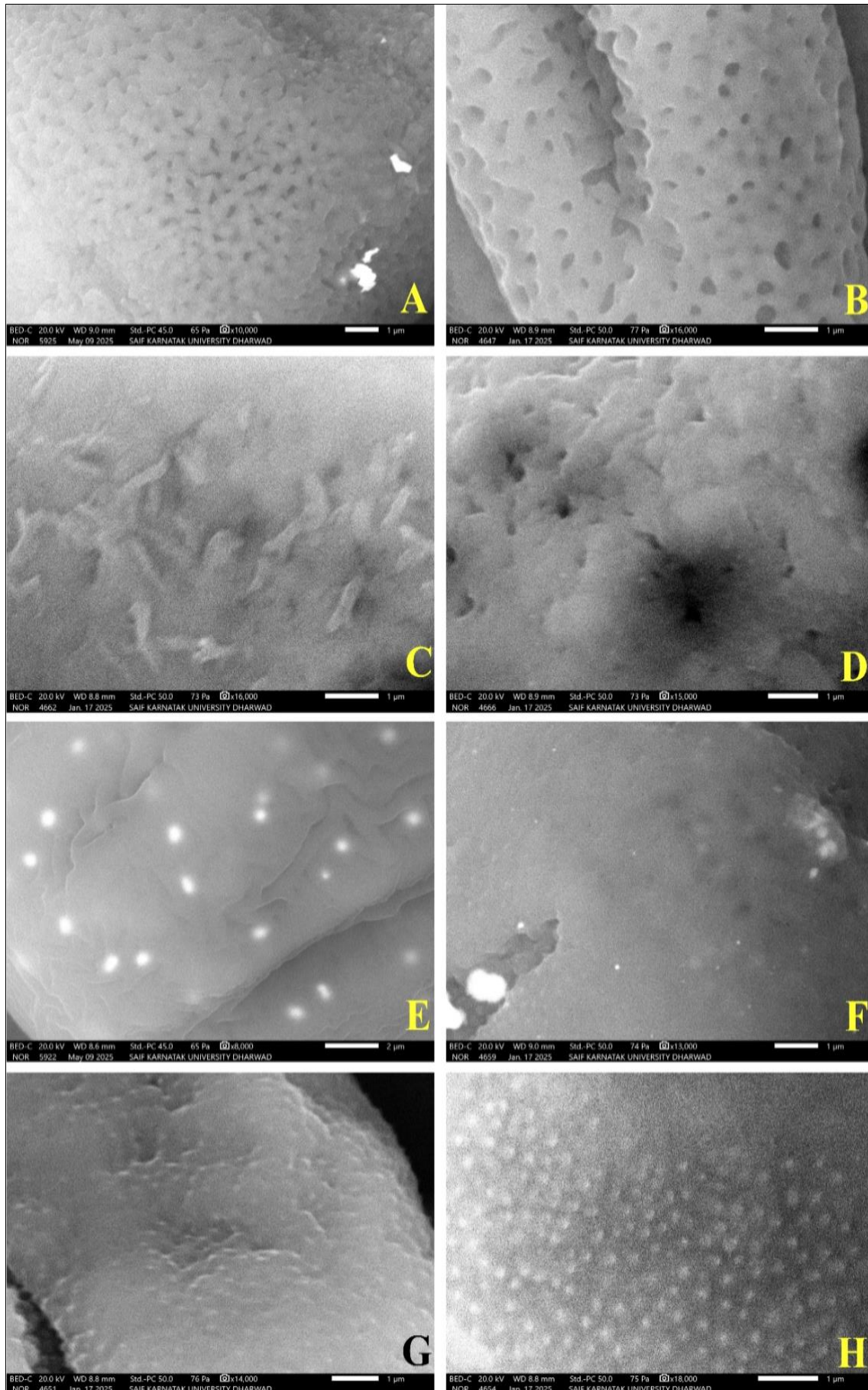


Fig 4: Pollen Surface of *Boraginaceae*: A. *Coldenia procumbens* L., B. *Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex Brand; C. *Euploca marifolia* (J. Koenig ex Retz.) Ancy & P. Javad; D. *Euploca ovalifolia* (Forssk.) Diane & Hilger; E. *Heliotropium amplexicaule* Vahl; F. *Heliotropium indicum* L.; G. *Heliotropium supinum* L.; H. *Trichodesma inaequale* Edgew.

***Trichodesma indicum* (L.) Sm.**

The pollen grains exhibit asubspheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 22.07µm, while average breadth is 16.83µm. And there is presence of Nodes.

***Trichodesma zeylanicum* (Burm.f.) R.Br.**

The pollen grains exhibit asubspheroidal shape which has a Tricolpate shape. The average length of the pollen grains is 18.71µm, while average breadth is 16.07µm. And there is presence of Nodes.

Conclusion

Many variations are there in pollen study of *Boraginaceae*. Need further more study to clear taxonomic conflicts between genera and species of *Boraginaceae* Juss. Pollens of this two species *Cynoglossum zeylanicum* (Sw. ex Lehm.) Thunb. ex Brand and *Heliotropium amplexicaule* Vahl. Were first time studied.

Acknowledgment

Authors are mainly thankful to USIC DST SAIF SEM Analysis, Karnatak University Dharwad for SEM photographs and measurements.

References

- Attar F, Esfandani-Bozchaloyi S, Mirtadzadini M, Ullah F. Taxonomic identification in the tribe Cynoglosseae *Boraginaceae* using palynological characteristics. *Flora*,2018;209:51317.
- Betageri S, Kotresha K. Seed morphometric with embryo diversity of wild orchids in North Karnataka. *Journal of Diversity Studies*,2024;3(1):1–12.
- Bhat KG. Flora of Udupi District. Indian Naturalist. Inchara, Chitpady, Udupi, 2003.
- Bhat KG. Flora of South Kanara. Dakshina Kannada and Udupi Districts of Karnataka. Udupi Taxonomy Research Centre. Chitpady, Udupi, 2014.
- Cooke T. Flora of the Presidency of Bombay. II. Botanical Survey of India,1906:1:174–228.
- Deshi S, Betageri S, Patagar GV, Kotresha K. *Cyperus melanostachyus* Kunth *Cyperaceae*. a new report to Indian flora. *Journal of Diversity Studies*,2025;4:73–77.
- Deshi S, Betageri S, Patgar VG, Kotresha K. Achene morphology of some genera of *Cyperaceae* Juss. in Karnataka. *Species*,2025;26:e41s3181.
- Gamble JS, Fischer CEC. Flora of Presidency of Madras. Secretary of State for India in Council,1928:3:1399–1478.
- IPNI. International Plant Names Index. Published on the Internet: <http://www.ipni.org>, The Royal Botanic Gardens, Kew, Harvard University Herbaria Libraries and Australian National Herbarium, 2025. [Retrieved 18 September 2025].
- Kamel MA, El Hadidy AMH, Hamed ST, Hussein NRA. A palynological review for some species of family *Boraginaceae* Juss. from the Egyptian flora. *Annual Research & Review in Biology*,2018;30(3):1–16.
- Kotresha K, Kambhar SV. Flora of Gadag District Karnataka. Lambert Academic Publishing, 2016.
- Kumar A, Sharma SS, Kumar B. Palynological studies on some plants of *Boraginaceae*. *IOSR Journal of Biotechnology and Biochemistry*,2020;6(5):4–12.
- Kumar B, Singh K, Kumar P, Batool Z, Dhiman SK, Gairola S. Palynological diversity of highly medicinal rare, endangered, and threatened plants from Western Himalaya, India. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*,2022;50(3):1–26. DOI: 10.15835/nbha50312787.
- Luebert F, Cecchi L, Frohlich MW, Gottschling M, Guilliams CM, Hasenstab-Lehman KE, *et al.* Familial classification of the Boraginales. *Taxon*,2016;65(3):502–522.
- Mary A, Gopal GV. Pollen morphology of selected taxa of Ehretiaceae from Western Ghats, India. *Annals of Plant Sciences*,2018;7(11):2446–2450.
- POWO. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet, 2025. <https://powo.science.kew.org/taxon/> [accessed: 18 September 2025].
- Saldanha CJ, Nicolson DH. Flora of Hassan District Karnataka. Amerind Publishing Co. Pvt. Ltd., New Delhi, 1976, 809–855.
- Saldanha CJ. Flora of Karnataka. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi, 1984, 1.
- Saldanha CJ. Flora of Karnataka. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi, 1996, 2.
- Seetharam YN, Kotresha K, Uploankar SB. Flora of Gulbarga District. Gulbarga University, Gulbarga, Karnataka, India, 2000.
- Sringeshwara AN, Sanjappa M. Flora of Karnataka, a Checklist. Gymnosperms and Angiosperms. Karnataka Biodiversity Board, Bangalore, 2019, 2.
- WFO. The World Flora Online WFO Plant List. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet, 2025. <https://www.worldfloraonline.org/> [Retrieved 18 September 2025].
- Yukti K, Betageri S, Patgar VG, Kotresha K. Nutlets morphology of some Lamiaceae in Karnataka. *International Journal of Botany Studies*,2025;10(8):39–43.