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Research Article

Anatomy & micro-morphological studies on epiphytic orchid *Oberonia ensiformis* (Orchidaceae) in Karnataka, India

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Abstract: *Oberonia ensiformis* is a fairy-tail orchid in Orchidaceae family which records fourth largest genus in Karnataka. *O. ensiformis* is distributed at moist-deciduous and semi-evergreen forests in Karnataka. Karnataka records 15 wild *Oberonia* species. The above work deliberates morphological colour plate, pollinia morphometry, seed morphometry and anatomical studies of *O. ensiformis*.

Keywords: Fusiform seeds, fimbrate labellum, green-yellow colour flower, sword-leaf *Oberonia*

Introduction

Orchidaceae is one of the diverse of monocots with 26,500 species with 692 genera across the world (POWO, 2025). The genus *Oberonia* was first described by Lindley in 1830, dedicating it to Oberon, the mythological king of fairies. While establishing the genus, *Oberonia* Lindl. is an old-world genus of mostly epiphytic herbs comprising of about 300 species (Mabberley, 2017). Lindley (1963) recognized 13 species of which four are from India (Lindley, 1963). Ansari and Balkrishnan recorded 41 species of *Oberonia* from India in the year 1990.There are around 1,256 species under 155 genera, of these 307 are endemic to India. Out of these, 63 *Oberonia* species are recorded (Singh et al., 2019). Flora of Karnataka analysis by Sharma et al., (1984), included *Oberonia belli* Blatt. & McCann. in his survey. Flora of Karnataka monocotyledons records 16 *Oberonia* species in that *Oberonia belli* and *Oberonia verticiliata* are recorded (Laxminarasimhan, et al., 2019). Karnataka also recorded 17 *Oberonia* species in the year 2019 (Sanjappa and Sringeswara, 2019). Rediscovery and taxonomic note on *Oberonia*

bellii Blatt. & McCann (Orchidaceae) in Karnataka after nine decades. *Oberonia bellii* Blatt. & McCann which was rediscovered after 91 years of T. R. Bell's manuscript with the characters like habit size, inflorescence length and modification, flower size and leaf arrangements (Shreyas and Kotresha, 2023). *Oberonia marnkuliensis* sp. nov. with the arrangement of the flowers, the petals larger than the sepals and the large lateral lobes of the lip with a sinuous margin, do not correspond to the characters of any known representative of the genus from India (Betageri and Kotresha, 2024).

Material and methods

The selected study area was Koppa taluk which comes under Malnad region of Chikkamagaluru district, Karnataka. Koppa is one of the seven taluks in Chikkamagaluru district and is known for its scenic beauty and rich vegetation. The major study area comprised of selected places of Koppa Forest Division and Kudremukh, along with other places of Koppa taluk. Koppa taluk is located at 13.53^0 N and 75.36^0 E. The temperature of this region varies between 18^0 C to 31^0 C and the annual rainfall is nearly 1600 to 3400 mm. The present study was carried out from June 2023 to October 2024 to get flowering and fruiting of individuals in wild (Betageri and Savadi, 2024).

SEM studies: Mature seeds were collected in dry form (zipper bag) giving those codes. The seeds were shade-dried and Scanning Electron Micrographs were collected. Same pollinia were stored in 70 % alcohol and Scanning Electron Micrographs were collected (Betageri and Kotresha, 2024).

Anatomical studies: Collected stem samples were stored in water for one day, washed in 100 % alcohol, sectioned, stained with safranin stain and observed under binocular microscope, the characters were recorded with photographs (Gulaguli et al., 2025).

Results and discussion

***Oberonia ensiformis* (Sm.) Lindl.** Fol. Orchid. 8: 4. 1859; Hook. Fl. British India, 5: 679. 1888; Gamble, Fl. Madras, 3: 1406. 1928; Saldanha, Fl. Hassan, 838. 1976; Sharma *et al.*, Fl. Karnataka. 274. 1984; Rao. Cons. Wild Orchids Kodagu. 215. 1998; Punekar & Lakshminarasimhan, Fl. Anshi, 472. 2011; Laxminarshimhan *et al.*, Fl. Karnataka, 3: 74. 2019; Sanjappa & Sringeswara, Fl. Karnataka Analysis, 2: 548. 2019 (Plate 1)

Pendulous epiphytes up to 30 cm long. Leaves sub-basal, 4-5, laterally compressed, ensiform, slightly falcate, 10-15 × 1.2-2 cm across, thick, base articulate, apex acuminate or long acuminate. Inflorescence 10-14 cm long, without inflorescence scar, many flowered; floral bracts sub-erect, sub-oblong, 2-3 mm, irregularly denticulate on apical margin, apex long acuminate. Flowers orange, 3 mm long. Outer whorl perianth (1) is broadly oblong-ovate, 1 mm across, apex obtuse; outer whorl perianth (2) is broadly ovate, similar to the outer whorl perianth (1) in size. Inner whorl perianth (1) is ovate-lanceolate, 1-2 mm across, apex acuminate; inner whorl perianth (2). Labellum is broadly ovate-oblong in outline, 2 mm, 3-lobed; lateral lobes suborbicular, margin erose; mid-lobe broadly obovate or sub-oblate, bilobed, margin slightly erose; disk with 2 calli, lateral at base of lateral lobes. Column short,

stout. Pollinia one pair, bean shaped orange. Anther cap white, with two sacks. Capsule obovoid-ellipsoid, 3 mm across, dull-green, ridged.

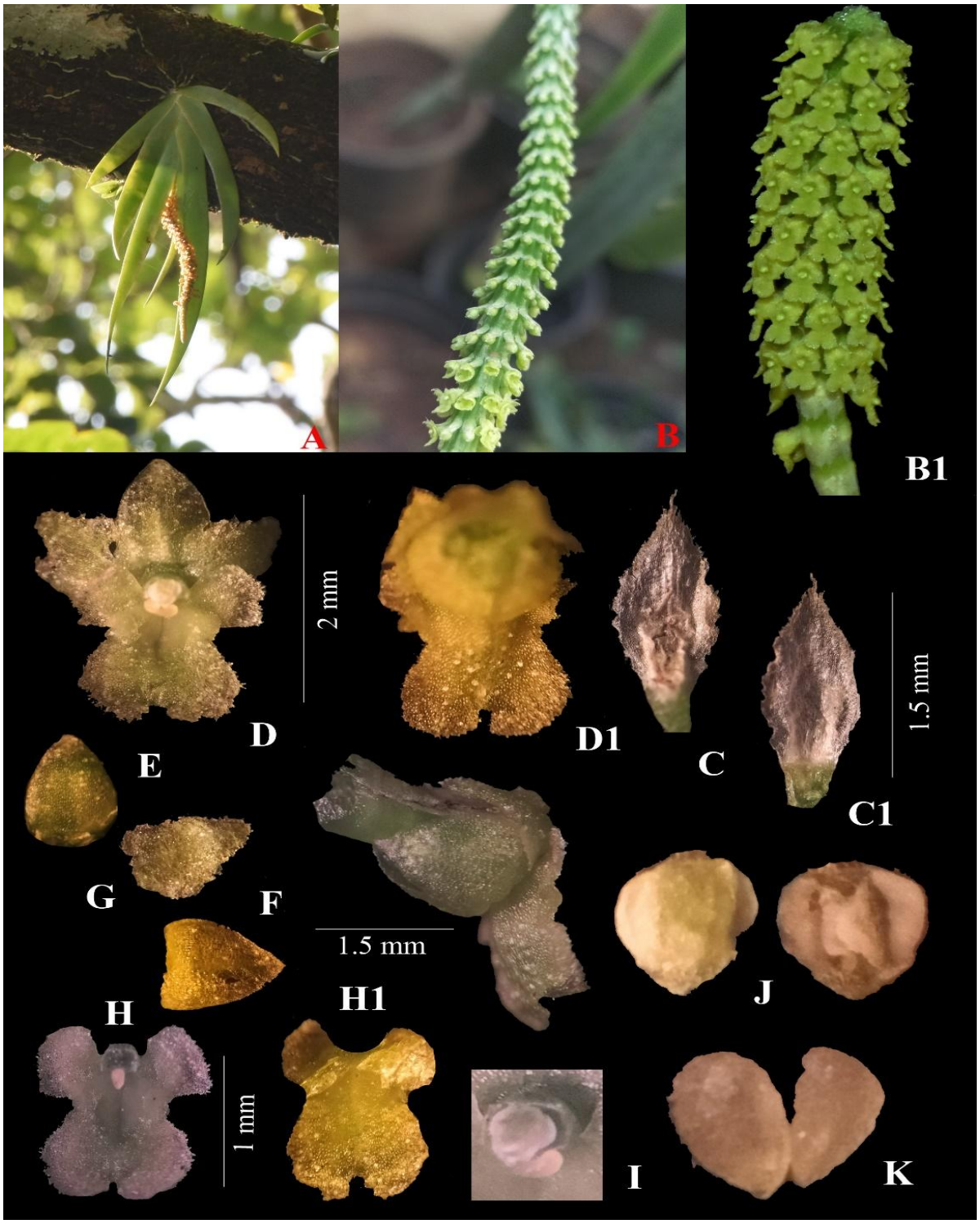

Plate 1: *Oberonia ensiformis* (Sm.) Lindl. A) Habit, B) Inflorescence, B1) Inflorescence enlarged, C) & C1) Bract, D) & D1) Dorsal and ventral view of flower, E) Dorsal sepal, F) Lateral sepal, G) Petal, H) & H1) Dorsal and ventral labellum, I) Column, J) Dorsal and ventral anther cap, K) Pollinia (Photography of Dr. Shreyas Betageri)

Flowering and fruiting: September-October

Collection site: Koppa taluk, Chikkamagaluru

Collector number and date: 308 (30-08-2023)

Latitude and longitude: 15°04'53.3" N and 74°31'20.2" E

Distribution in Karnataka: Belgavi, Uttara Kannada, Dakshina Kannada, Udupi and Kodagu.

Anatomy of leaf: T.S. of leaf (Plate 2) shows acute apex or sometimes with retuse apex. Upper and lower epidermis is one-layered with circular shape with thin cuticle. Mesophyll layer shows circular shape without air space. Small vascular bundles are distributed in between mesophyll layer. Vascular bundles are too small made up of thick layered sclerenchyma cells surrounding xylem and phloem. Raphide bundles are present. Stomata are anisocytic showing less distribution of stomata. Stomatal index is calculated (Table 1).

Table 1: Stomatal type, distribution and index of *Oberonia ensiformis* (Sm.) Lindl.

Scientific name	Stomata Type	SL (μm^2)	SW (μm2)	ECL (μm^2)	ECW (μm^2)	Total no. of stomata	Total no. of Epidermal cells	Stomatal Index (in %)
Oberonia ensiformis (Sm.) Lindl.	Anisosytic	5	3	4	2	14 (10X)	56 (10X)	20 %
						3 (40X)	12 (40X)	20 %

(SL- Length of stomata; SW- Width of stomata; ECL- Length of Epidermal cell; ECW- Width of Epidermal cell)

Pollinia morphometry: Pollinia is light yellow colour. They are bean-shaped with acute apex at base, obtuse apex at top. Tetrads are reticulate with measurements (Table 2; Plate 3).

Table 2: Pollinia morphometry of *Oberonia ensiformis* (Sm.) Lindl.

Scientific name	Shape of Pollinia	Length (μm)	Breadth (μm)	L/B	Tetrad shape	LT (μm)	BT (μm)
Oberonia ensiformis (Sm.) Lindl.	Bean shaped without tegula & viscidium	207.1	127.1	1.62	Reticulate with irregular shape	18.91	11.03

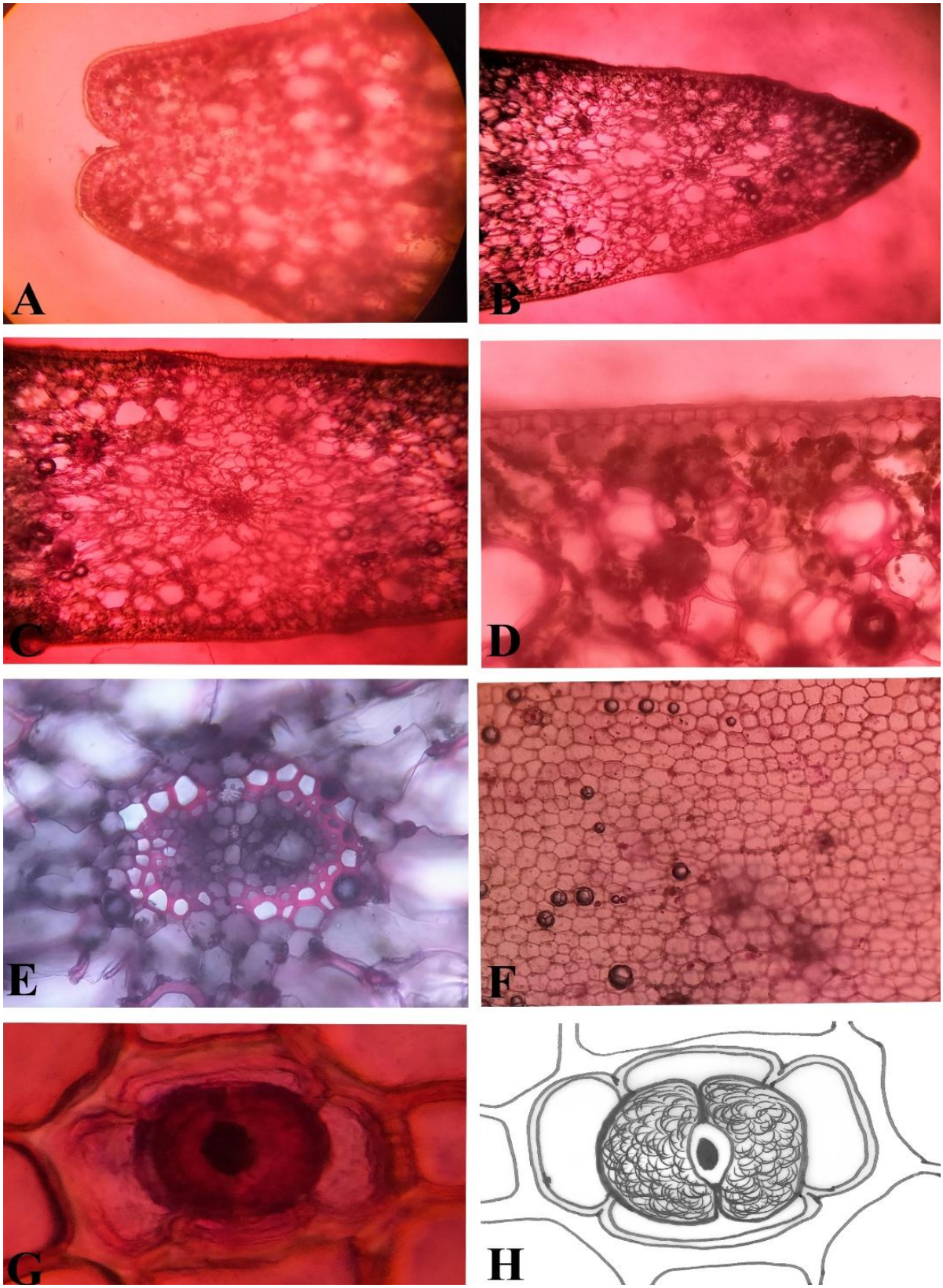

Plate 2: *Oberonia ensiformis* (Sm.) Lindl. A) B) T.S. of Leaf apex, C) Leaf showing upper and lower epidermis, D) Upper epidermis with mesophyll cells, E) Single vascular bundle, F) Peel of leaf showing stomata, G) Ansiocytic stomata, H) Illustration of stomata (Photography of Dr. Shreyas Betageri)

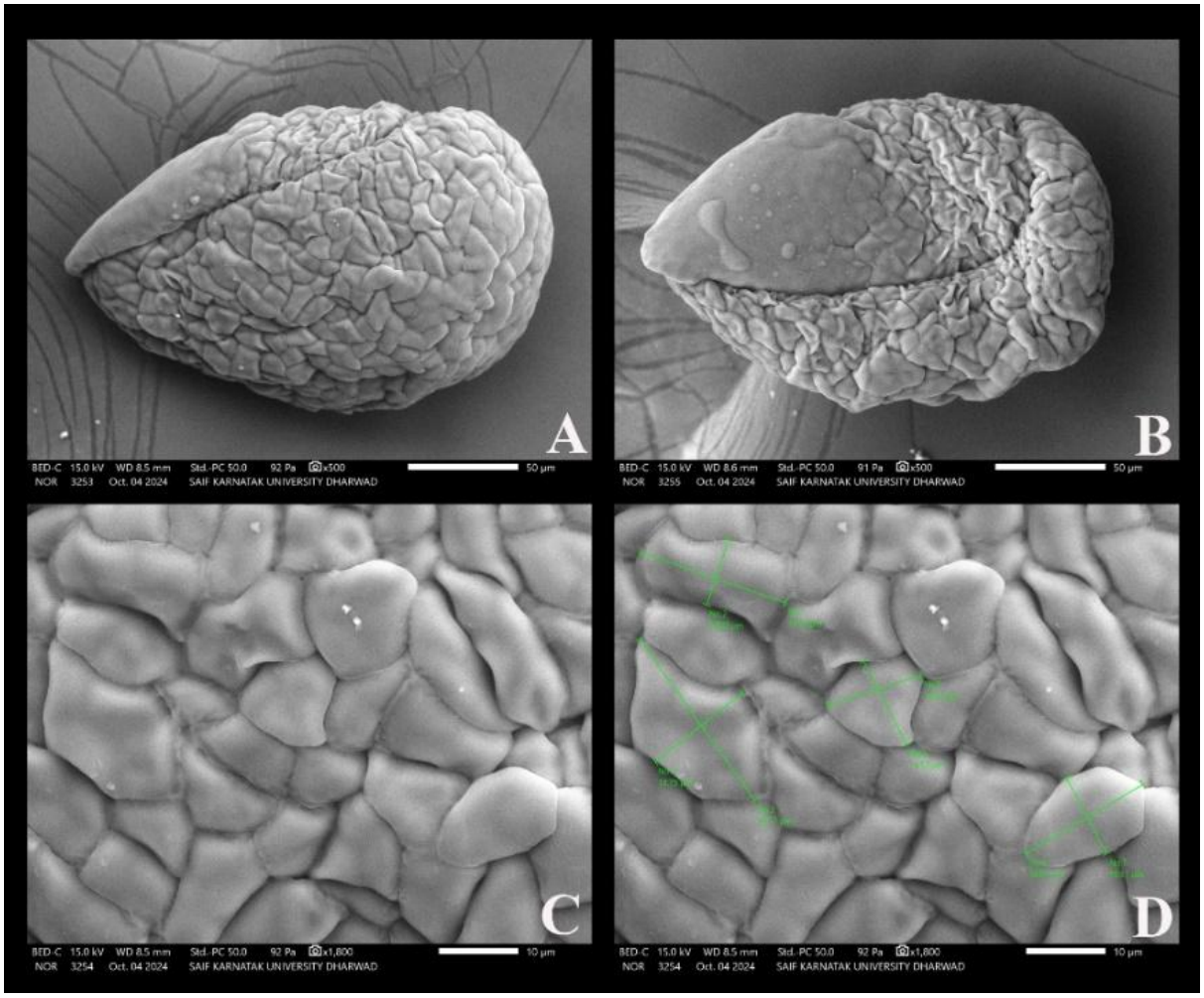

Plate 3: *Oberonia ensiformis* (Sm.) Lindl. A) Dorsal view of pollinia, B) Ventral view of pollinia, C) Surface view of pollinia showing tetrads and D) Measurements of tetrads

Seed morphometry: Colour of seed show grayish black. Shape of seed is fusiform shape (Plate 4), not all *Oberonia* species show this type of shape. Other parameters are recorded in the table 3 and 4.

Table 3: Seed morphometry of *Oberonia ensiformis* (Sm.) Lindl.

Scientific name	LS (mm)	WS (mm)	L/W (mm)	SV ($mm^3 \times 10^3$)	LT (mm)	WT (mm)	L/W (mm)	CL
Oberonia ensiformis (Sm.) Lindl.	0.05±0.024	0.04±0.01	13.25	0.36	0.09±0.006	0.009±0.004	10	GB

[(Mean)± SE (Standard Error); LS- Length of Seed; WS- Width of Seed; L/W- Length/ Width ratio of seed; LT- Length of testa cell; WS- Width of testa cell; L/W- Length/ Width ratio of testa cell; CL- Colour]

Table 4: Embryo parameters of *Oberonia ensiformis* (Sm.) Lindl.

Scientific name	EL (mm)	EW (mm)	L/W (mm)	EV ($mm^3 \times 10^3$)	SV/EV	AS

Oberonia ensiformis (Sm.) Lindl.	0.202±0.001	0.02±0.0006	10	0.014	21.42	96.11%

(EL- Embryo length; EW- Embryo width; L/W- Length/ Width ratio of embryo; EV- Embryo volume; SV/EV- Seed volume/ Embryo volume; AS- Air space)

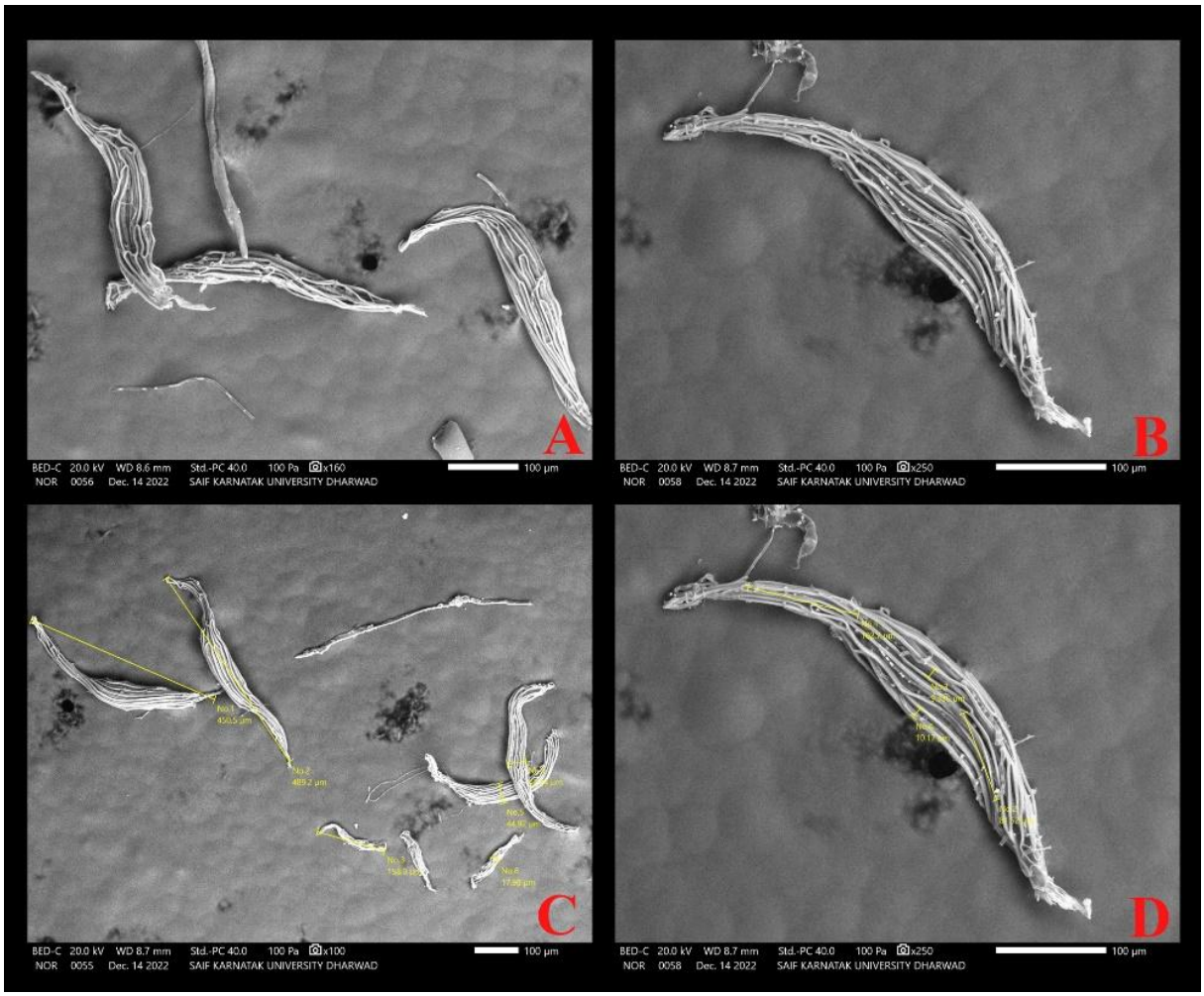

Plate 4: *Oberonia ensiformis* (Sm.) Lindl. A) Seeds, B) Single seed, C) Measurements of seeds and D) Measurements of testa cells

Conclusion

As *Oberonia ensiformis* is endemic to Western Ghats (evergreen, semi evergreen and moist deciduous forests), its flowering is unique depending on forest type. During survey, the authors recorded two colours in flowers i.e., green and golden yellow. This species is confused with *Oberonia vertciliata*, *Oberonia chandrshekranii* which can be easily identified with this anatomy work, pollinia and seed morphometry also during fruiting season.

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