

COMPARATIVE ANATOMY OF THE AERIAL ROOTS OF BLUE AND RED VANDAS AND ITS DIAGNOSTIC SIGNIFICANCE

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ABSTRACT

The two highly endangered orchid species, *Vanda coerulea* Griff. ex Lindl. (Blue Vanda) and *Renanthera imschootiana* Rolfe (Red Vanda), could be easily identified when those are in flowering states. However, it is difficult to identify them in their vegetative conditions since both of the species resemble one another in apparent morphology. In the present study, efforts have been made to identify them in their vegetative conditions by the anatomical structures of aerial roots studied under SEM (Scanning Electron Microscope) as well as Light Microscope. The presence of medullary bundles in Red Vanda seems to be a unique diagnostic feature, which could be used to identify the said plant species in its vegetative condition.

INTRODUCTION

Orchids are important economic plants primarily for their ornamental use. Based on the floral colours, the two epiphytic species of Orchidaceae, *Vanda coerulea* Griff. ex Lindl. and *Renanthera imschootiana* Rolfe, are commonly referred to as Blue Vanda and Red Vanda respectively. Both of the species are native to the Indo-Burmese mega-biodiversity hotspot and they occur in high altitudes in the North-eastern States of India and the adjoining areas of Western Myanmar (Nayar & Sastry, 1990; Kishor & Sharma, 2005). Those are very much in demand for their beautiful ornamental flowers and are highly priced all over the world. Besides, the leaves and flowers of *Vanda coerulea* are used traditionally in folk-medicine (Vij & Aggarwal, 2003). *Vanda coerulea* flowers during September to February with October-November as the peak flowering season. Sometimes, the species flowers beyond its flowering season in the month of June (Nayar & Sastry, 1990; Kishor & Sharma, 2005). Pale to dark blue flowers are relatively large and with dark tessellations. *Renanthera imschootiana* is the only species of the genus *Renanthera* that occurs in India. The species flowers during April and May in Manipur (Kishor & Sharma, 2005); May to July in Assam (Bose & al., 1999); September and October in Arunachal Pradesh (Chowdhery, 1998). The spectacular orange-red flowers are long lasting and thereby the species is highly valued in horticulture as an ornamental. Both of the species are highly endangered in their natural habitats. *Vanda coerulea* is listed in Appendix I of CITES. In 1975, *Renanthera imschootiana* was included in appendix II of CITES. Later on, it was up-listed to Appendix I in 1979. Endorsing the CITES decision, in 1998, the Government of India has placed both the plant species in the Negative list of Export, which bans collection from wild sources (Chowdhery, 1998; Kishor & Sharma, 2005).

Vanda coerulea (Blue Vanda) and *Renanthera imschootiana* (Red Vanda), could readily be identified when those are in their flowering states. However, it is difficult to distinguish them in their vegetative conditions since both the species resemble one another in apparent morphology.

The present study involves anatomical studies of the aerial roots of the species by SEM (Scanning Electron Microscope) as well as Light Microscope to have a means of their identification in vegetative states. It may be mentioned that there is no report so far on the SEM studies of the aerial roots of these taxa.

MATERIALS AND METHODS

The specimens of *Vanda coerulea* and *Renanthera imschootiana* required for the present study were collected from the Orchidarium of Botanical Survey of India of Shillong and Gangtok respectively, which were identified by consulting State floras and also by comparing with the authentic specimens deposited in different Indian herbaria viz. Central National Herbarium, Howrah (CAL), Botanical Survey of India, Eastern Circle, Shillong (ASSAM) and Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC). The voucher

specimens were deposited in the Crude Drug Museum (CDM) of Pharmacognosy Unit, Botanical Survey of India, Howrah.

For Scanning Electron Microscopy, transverse sections of fresh or FAA-fixed aerial root (without gold coating) were directly mounted on a double-sided adhesive tape, which was already fixed on a metallic specimen stub. Later, the specimen stubs were placed over the Stage located in the specimen chamber of the Electron Microscope and scanned at different magnifications under High Vacuum mode of a FEI's Quanta 200 (Netherlands) Scanning Electron Microscope installed at Central National Herbarium, Botanical Survey of India, Howrah.

To supplement the SEM studies, light microscopic studies of the anatomical features of the said orchid species have also been carried out under an Olympus CX41 Microscope. In addition to the visible light for normal structural observations, polarized light was employed to observe critically the lignified cells. Photomicrographs were taken using an Olympus Digital Camera attachment (5.1 megapixels). Photomicrographs have been labeled using following abbreviations: Co-Cortex; En-Endodermis; Ex-Exodermis; Fi-Fibres; Mvs-Medullary vascular strand; Pa-Parenchyma cells; Pc-Pericycle; Pe-Phloem elements; Pi-Pith; Rh-Rhizodermis; Sg-Starch grains; St-Stele; Vt-Velamen tissue; Xe-Xylem elements.

OBSERVATIONS

Vanda coerulea Griff ex Lindl. : The aerial root of *V. coerulea* shows the following structures under SEM and light microscope. Rhizodermis is constituted of a single row of radially elongated thin walled cells, followed by 3 to 4 layers of velamen tissue comprising radially elongated, thin walled cells. Inner to the velamen, there is a wider exodermal layer of radially elongated thin walled compact cells. Inner to the exodermis is a wide cortex of homogeneous parenchyma. Under light microscope, needle like calcium oxalate crystals are seen in most of the cortical cells. Inner to the cortex is the broad, circular stele at the centre. The endodermis is made up of a layer of thick walled squarish cells with thin walled wide passage cells at intervals of 7 to 10 thick walled cells. The pericycle has 2 layers of cells, the outer layer of thick walled rectangular cells and the inner layer of thick walled polygonal. The vascular tissue consists of 15 exarch xylem strands alternating with wide circular masses of thin walled phloem elements. The cells surrounding the xylem and phloem strands are smaller with thick lignified walls. Pith is wide and consists of angular, compact, thick walled sclerenchyma cells. **(Pl. 1 & 2)**

Renanthera imschootiana Rolfe : The aerial root of *Renanthera imschootiana* shows the following structures under SEM and light microscope. Rhizodermis has a single layer of thin walled radially elongated cells. The velamen consists of 2 to 4 layers of radially elongated, thin walled and compact cells. The exodermis consists of a layer of radially elongated, thick walled cells. Inner to the exodermis is a relatively narrow zone of cortex consisting of small, angular, thin walled compact parenchyma cells with needle like calcium oxalate crystals. The stele is wider and circular. The endodermis consists of a layer of squarish thick walled cells with thin walled passage cells at intervals of 5 to 7 endodermal cells. The vascular tissue consists of 25 to 35 exarch xylem strands alternating with radially stretched masses of thin walled phloem elements. The ground tissues surrounding the xylem and phloem strands are smaller with thick lignified wall. The central pith is of fairly thick walled parenchyma cells. The pith parenchyma cells are heavily loaded with starch grains. **(Pl. 3 & 4)**

CONCLUDING REMARKS

Aerial roots of Blue Vanda and Red Vanda, in anatomical features, fundamentally resemble each other. However, those can be distinguished readily by presence of starch grains in the pith parenchyma cells of Red Vanda and their absence in the Blue Vanda and presence of 3 prominent medullary vascular strands in Red Vanda and absence of medullary vascular bundles in Blue Vanda. Those contrasting features enable the identification of the two orchid species in their vegetative condition.

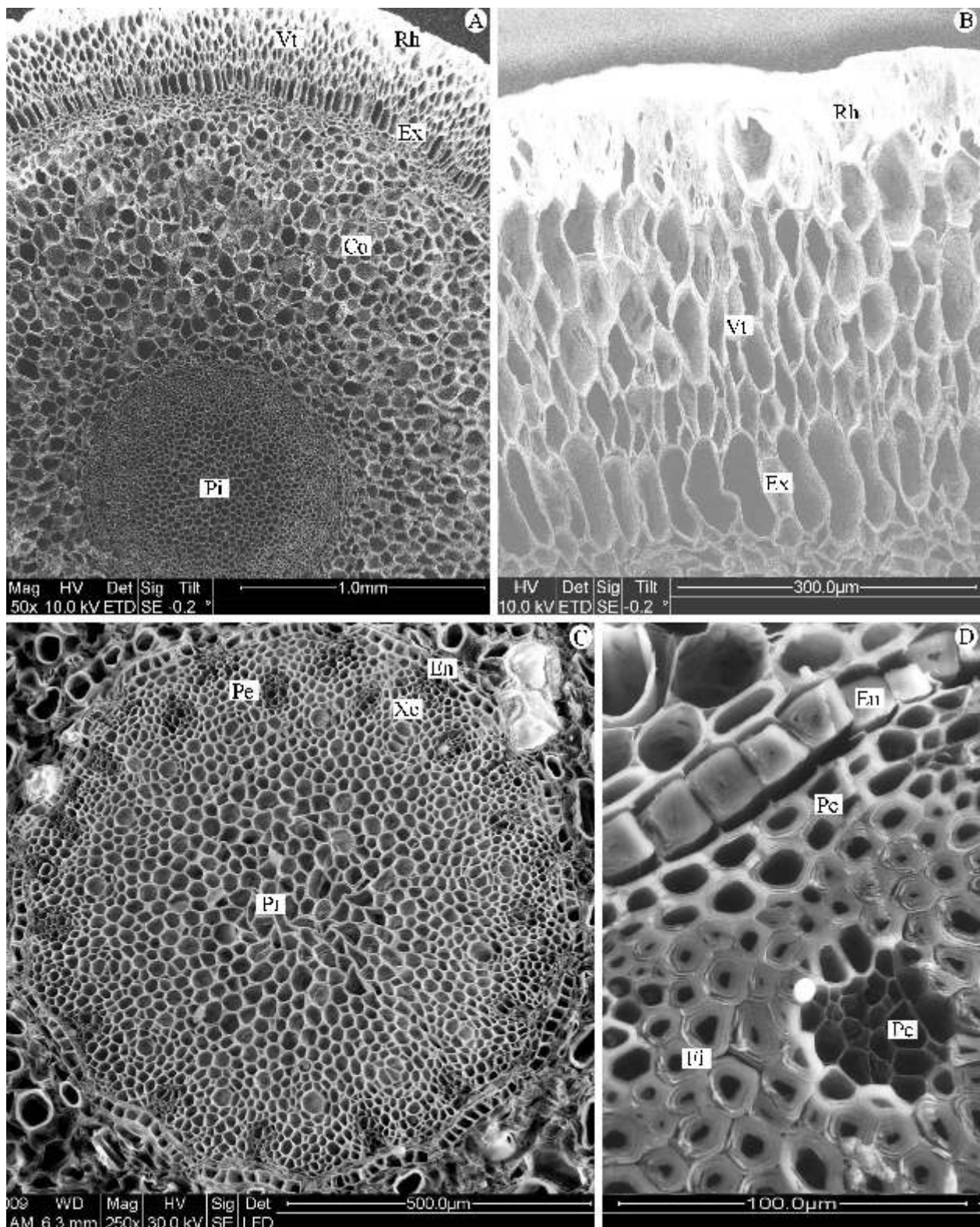


Plate - 1: SEM photomicrographs of aerial roots of *Vanda coerulea* in transectional view; **A.** Transverse section of aerial root - a sector (50x); **B.** Velamen tissue and exodermis-close up view (200x); **C.** Aerial root showing structure of the stele (250x); **D.** Endodermis, pericycle and vascular elements - close up view (1000x).

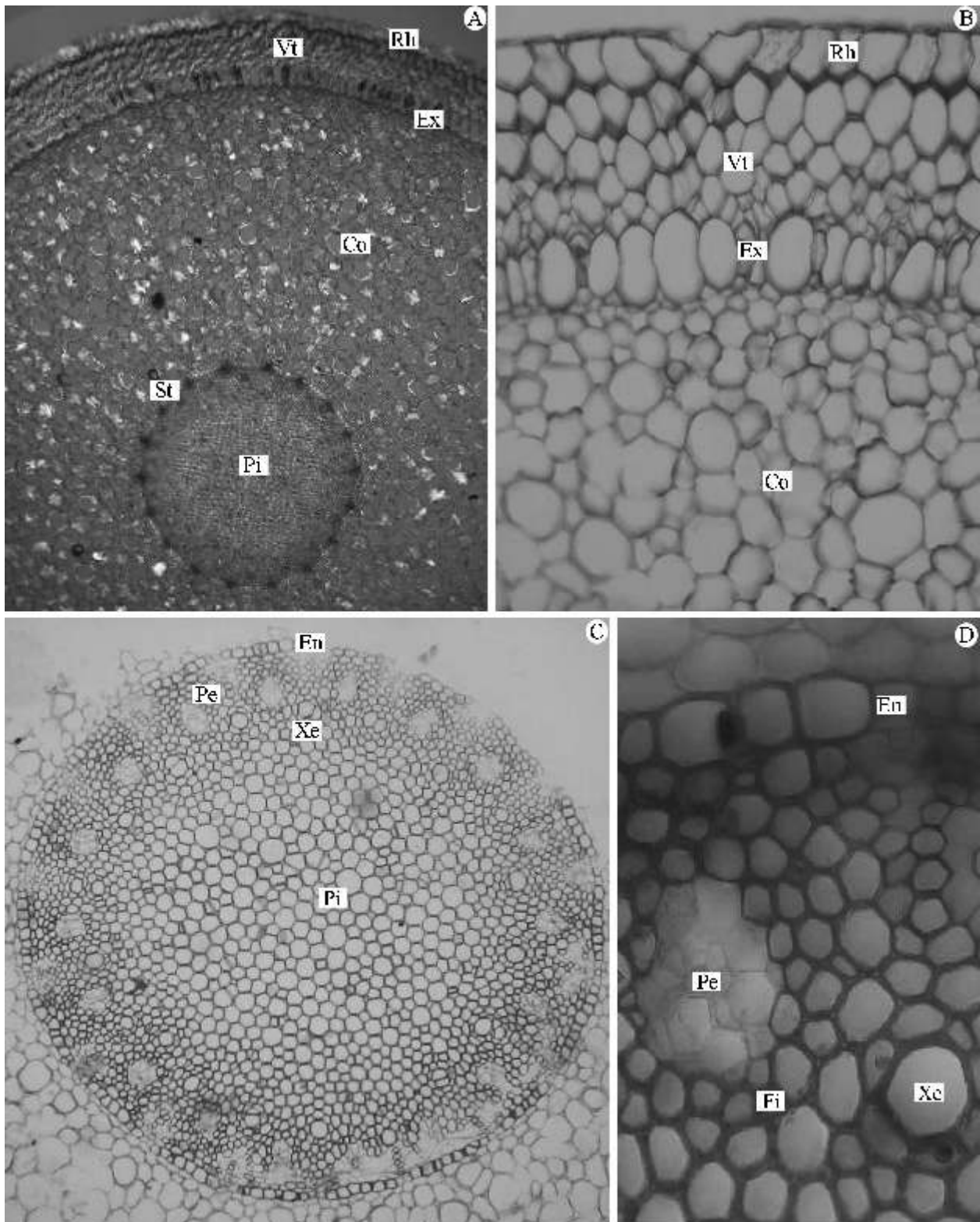


Plate - 2 : Light microscopic studies on the aerial root of *Vanda coerulea*; **A.** Transverse section of aerial root - a sector; **B.** Rhizodermis, Velamen tissue, exodermis and cortex- close up view; **C.** Aerial root showing structure of the stele; **D.** Endodermis, vascular elements and sclerotic pith-close up view.

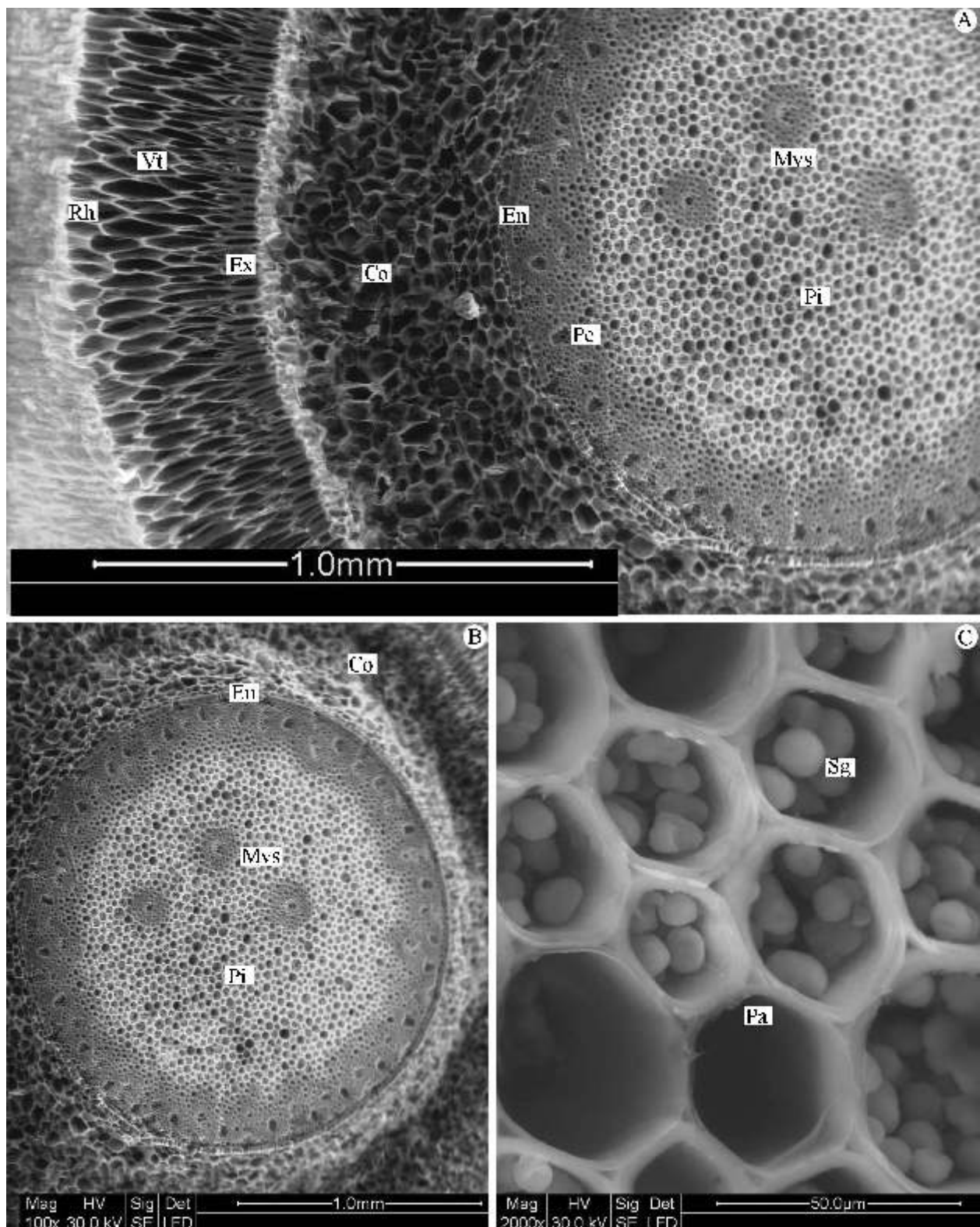


Plate - 3 : SEM photomicrographs of aerial roots of *Renanthera imschootiana* in transectional view; **A.** Transverse section of aerial root - a sector (100x), showing rhizodermis, velamen tissue, exodermis, cortex, endodermis, vascular tissues, three medullary vascular strands and pith; **B.** Stele showing endodermis, vascular tissues, three medullary vascular strands and pith (100x); **C.** Ground parenchyma cells (pith) showing starch grains (2000x).

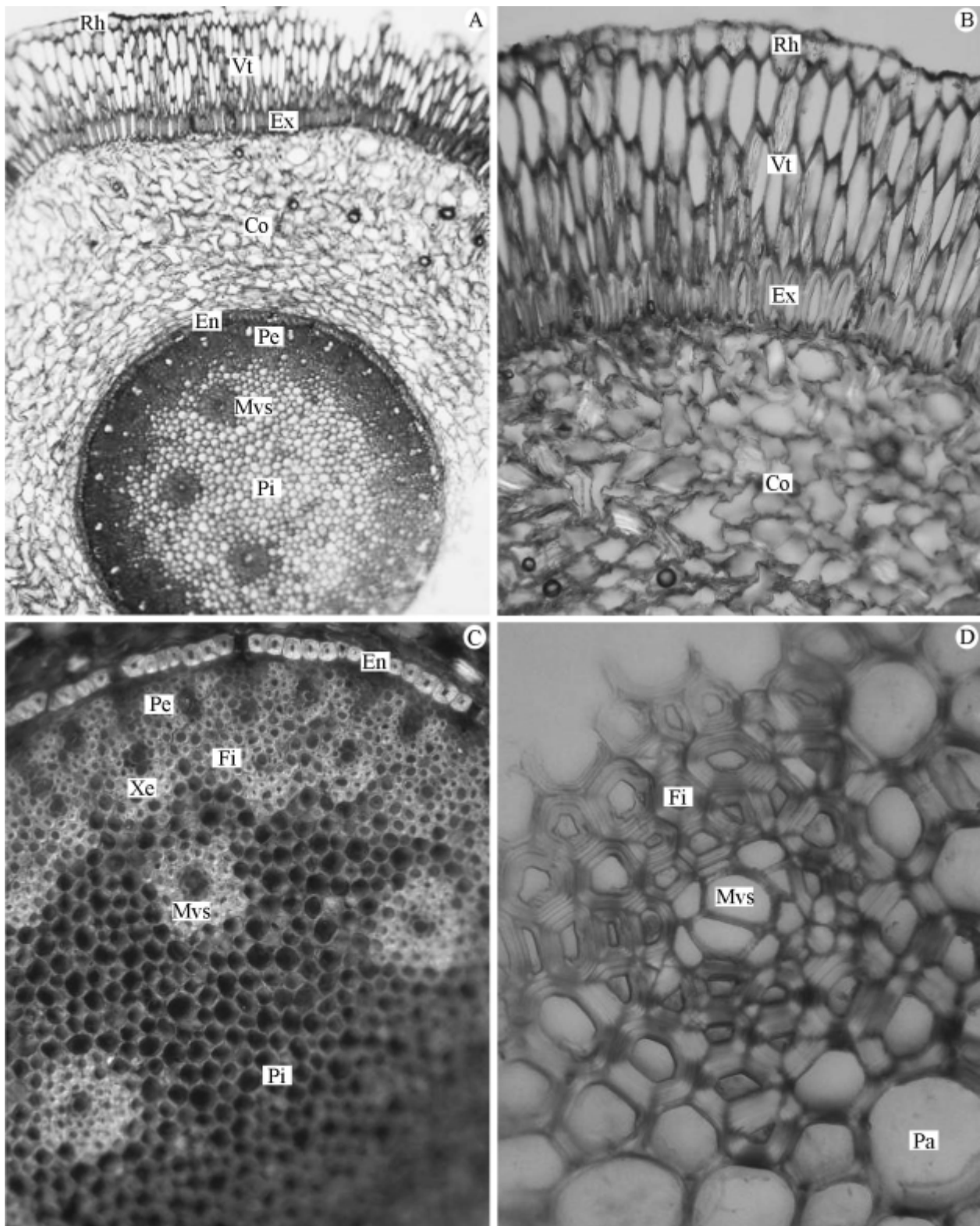


Plate - 4 : Light microscopic studies on the aerial roots of *Renanthera imschootiana*; **A.** Transverse section of aerial root - a sector; **B.** Rhizodermis, Velamen tissue, exodermis and cortex - an enlarged view; **C.** Structure of the stele - showing three medullary vascular strands and pith; **D.** An enlarged view of a medullary vascular strand surrounded by fibres and parenchyma cells.

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REFERENCES

- BOSE, T.K., S.K. BHATTACHARJEE, P. DAS AND U.C. BASAK. 1999. Orchids of India, pp. 417. Naya Prokash. Calcutta.
- CHOWDHURY, H. J. 1998. Orchid flora of Arunachal Pradesh, pp. 626, 682-685. Bishen Singh Mahendra Pal Singh. Dehra Dun.
- JOHANSEN, D.A. 1940. Plant Microtechnique, pp. 523. Mc Graw Hill Book Co. New York.
- KISHOR, R. AND G.J. SHARMA. 2005. *Renantanda* Kebisana Shija, *The Orchid Review* (Royal Horticultural Society). Vol. 113 (1266), 325-327.
- LOTT, JOHN N.A. 1976. A Scanning Electron Microscope study of Green plants, The C.V. Mosby Company. Saint Louis. 1 & 2.
- METCALF, C.R. AND L. CHALK. 1957. Anatomy of the Dicotyledons - Leaves, stem and wood in relation to taxonomy with notes on Economic uses, Oxford University Press. London. Vol. I, xi-xiv.
- NAYAR, M.P. AND A.R.K. SASTRY. 1987. Red data book on Indian plants, Vol. I, pp.278. Botanical Survey of India. Kolkata.
- NAYAR, M.P. AND A.R.K. SASTRY. 1990. Red data book on Indian plants, Vol. III, 202 & 203. Botanical Survey of India. Kolkata.
- SASS, J.E., 1940. Elements of Botanical Microtechnique, pp. 222. Mc Graw Hill Book Co. New York.
- TROUGHTON, J.H. AND F.B. SAMPSON. 1973. Plants: A Scanning Electron Microscope Survey, John Wiley & Sons Australasia Pty Ltd. Sydney.
- VII, S.P. AND S. AGGARWAL. 2003. Regenerative competence of foliar explants: *Vanda coerulea* Griff., *J. Orchid Soc. India*. 17(1-2): 73-78.

नीले एवं लाल वेंडा की झिल्ली की वायवीय मूल से तुलनात्मक शरीर रचना तथा इसका निदान सूचक महत्व

ए बी डी सेल्वम

सारांश

आर्किड की दो अत्यन्त संकटापन्न जातियों *वेंडा सेरुलिआ* (नीला वेंडा) एवं *रेनेन्थेरा इम्पूटिएना* (लाल वेंडा) को पुष्पित अवस्था में आसानी से पहचाना जा सकता है। दोनों जातियों की आकारिकी में समानता के कारण कायिक अवस्था में अभिनिर्धारण कठिन है। इस आलेख में एस इ एम तथा लाइट माइक्रोस्कोप के अंतर्गत वायवीय मूल की शरीर रचना द्वारा कायिक अवस्था में अभिनिर्धारण का प्रयास किया गया है। लाल वेंडा में मज्जक गुच्छों की उपस्थिति की अद्भुत निदान सूचक विशेषता से उक्त पादप जातियों की कायिक अवस्था में अभिनिर्धारण हेतु उपयोग किया जा सकता है।