



International Journal of Advance Studies and Growth Evaluation

Morpho-Anatomical Study of *Schoenoplectiella praelongata* (Poir.) Lye Cyperaceae

^{*1} Habiba AM Sayekar and ² Raghunath L Ghalme

^{*1,2} PG and Research Laboratory, Department of Botany, Dapoli Urban Bank Senior Science College, Dapoli, Maharashtra, India.

Article Info.

E-ISSN: **2583-6528**

Impact Factor (QJIF): **8.4**

Peer Reviewed Journal

Available online:

www.alladvancejournal.com

Received: 26/May/2026

Accepted: 23/June/2026

Abstract

The *S. praelongata* is annual herb grows in semiarid tropical soil and seasonally dry soil inhabiting margins of wetlands and marshy swamps. Morpho-anatomical study carried on this plant shows that, this plant follows C3 photosynthetic pathway as it lacks kranz sheath in bract, leaf sheath and culm. Schizogenous cartwheel aerenchyma predominant in bract and sheath whereas 2 different types of peripheral and central air cavities observed in culm and lysogenous aerenchyma present in root. Amphivasal atactostele present in rhizome and crescentiform large sclerenchyma present below vascular bundles. The inner cells of air cavities are reticulate parenchyma and outer cells of diaphragms silicified.

*Corresponding Author

Habiba AM Sayekar

PG and Research Laboratory,
Department of Botany, Dapoli Urban
Bank Senior Science College, Dapoli,
Maharashtra, India.

Keywords: *S. praelongata*, boat like obtuse glumes, rugulose pyriform nut, non-kranz anatomy, amphivasal atactostele.

Introduction

India represents 12 species of *Schoenoplectiella* out of these Maharashtra represents 7-8 species. Earlier the species of *Schoenoplectiella* were placed in different genera of cyperaceae such as *Schoenoplectus* and *Scirpus*. *Schoenoplectiella* Lye is a small genus separated from *Schoenoplectus* in Cyperaceae and the sedges belong to this genus are annual tufted amphicarpous or non amphicarpous or perenniels emergent or submerged and inhabiting wetlands. Culms erect slender terete, trigonous to several angled either nodeless or 1-3 noded. Roots fibrous. Leaves reduced to blade less scale like basal sheaths. Nut planoconvex to trigonous, rugulose to smooth. Basal pistillate flower present or absent. (Sudhakar *et al.* 2023).

Schoenoplectus represents 77 species worldwide out of these some species shifted from this genus to newly formed geuns *Schoenoplectiell* this includes *S. praelongat*, *S. articulata*, *S. lateriflora*, *S. mucronata* and *S. juncooides* etc. the species like *S. grossus*, *S. mucronata* and *S. juncooides* grows in wetland, marshes and paddy fields hence possesses problems in paddy cultivation (Bryson & Carter (2008).

The organographic study revealed the *S. praelongata* (Poir.) Lye occurrence of pseudo-vivipary and the co-occurrence of amphicarp in the different ramets of the same genet in this plant species (Das U. *et al.* 2025).

The morphological, reproductive and organomorphic studies carried on *S. praelongata* before. However, anatomical and phytochemical studies on many *Schoenoplectiella* were not available hence, in this study we analysed *S. praelongata* anatomy which will significantly contribute in delimitation of taxa.

Methodology

The *Schoenoplectiella praelongata* (Poir.) Lye, belonging to the family Cyperaceae collected from Velas village of Dapoli tehsil, Maharashtra situated at N. 17.94595, E 73. 03059. The collected specimen brought to the lab dissected under trinocular stereo-microscope and identified by using digital herbarium sheets, state flora.

After identification, dried specimen used for anatomical study. First dry specimen processed through boiling in water until it rehydrated and regains its original texture by following

method given by Metcalfe in 1970. Then it fixed and kept into FAA solution for overnight. After washing for several times thin transverse sections of culm, bract, leaf sheath, root and rhizome were taken through free hand section technique. Sections were bleached into 37% Sodium hypochlorite solution for 2 hours and then washed several times with distilled water to remove traces. Pre staining of sections done by using diluted toluidine blue O stain and then wash and transferred into series of ethanol ranging from 10% - 100% absolute alcohol for dehydration for about 10-1 minutes in each gradient. Temporary slides prepared after mounting section in glycerine and observed under trinocular light microscope LX 500 attached with camera UCMOS10000KPA, the characters were noted and microphotography of each section done.

Results

A. Morphology

The *S. praelongata* (Poir.) Lye is slender, erect tufted sedge inhabiting semiarid tropical, margins of wetlands, swamps areas, and grows in seasonally dry soil. The plant usually attains 10- 50 cm height including 5-10 cm tall terete to sub

terete culm and much overtopping stem like bract nearly 30-40 cm long (Fig. 1B). Leaves reduced to blade less, bifurcated striated, glabrous straw brown cauline sheath. Involucral 1 bract terete – subterete, culm like, much overtopping inflorescence, narrowly septate, striated 30-40 cm long and 6-7 mm wide. Inflorescence capitate spike, sessile, 2.5×2.5 cm long and wide. Spikelets angular umbonulate, shape ellipsoid-ovate $7-8 \times 4$ mm long and wide, mucous, bisexual hypogynous flowers spirally arranged and caducous. Rachilla persistent and wingless. Glume $3.5 \times 2.5-2.7$ mm long obovate-suborbicular, sides and margins striated, apex obtuse with inwardly recurved mucro. Keel multi-nerve boat like (Fig.2a-c.). Stamens 3 and filaments were basifixed. Style bifid, longer than nut *ca.* 2.2 mm long with 0.2-0.5 mm long bifurcated stigma, glabrescent caducous, style base straight. Nut trigonous pyriform, obovate $1.8-2 \times 1-1.2$ mm, surface rugulose with 10-25 horizontal wavy rows of epidermal cells, apex apiculate rounded and broader than base, gradually narrowed minutely stipitate base. Gynophore disc flattened oval. Colour chestnut brown. Hypogynous bristles setiform longer than nut (Fig.2d-f).



Fig 1: *Schoenoplectus praelongata* (Poir.) Lye: A. plant in natural habitat & B. dried plant specimen.



Fig 2: *S. praelongata*: a. Inflorescence, b. spikelet, c & f. glume and bifid style, d & e. nut and perianth bristles

B. Anatomy

T. S. of Bract

The bract appeared terete in transverse section $7 \times 4-5$ mm with many ridges and furrows on surface. Epidermis single layer thinly cuticularized and the cells of epidermis cuboidal followed by many sclerenchyma scattered underneath of epidermis specifically beneath the furrows. Cortex ground

parenchymatous composed of 2-3 layered palisade and 6-7 layered spongy parenchyma and cartwheel aerenchyma. About 70-80 air cavities $519-530 \mu\text{m}$ in length, the shape varies from cuboidal to hemispherical and regularly alternating with vascular bundles (Fig. 3a & b). Diaphragm 3-4 cells thick and vascular bundles situated in this region. Vascular bundles many, conjoint collateral closed and

categorized into 2 types based on size, large vascular bundle 630 μm and small differentiated bundles 372.03 μm both types surrounded by parenchymatous complete layer bundle sheath and 2-3 layered polygonal incomplete circumvascular sclerenchyma 110 μm , xylem lacuna 160 μm present only in

large bundles. Xylem vessels in large vb. s 125 μm and 56.195 μm in small vascular bundle similarly, phloem regular and in large bundles 150 μm and 101.81 μm in small bundles (Fig.2 c-f). The large hollow air cavity present at the centre.

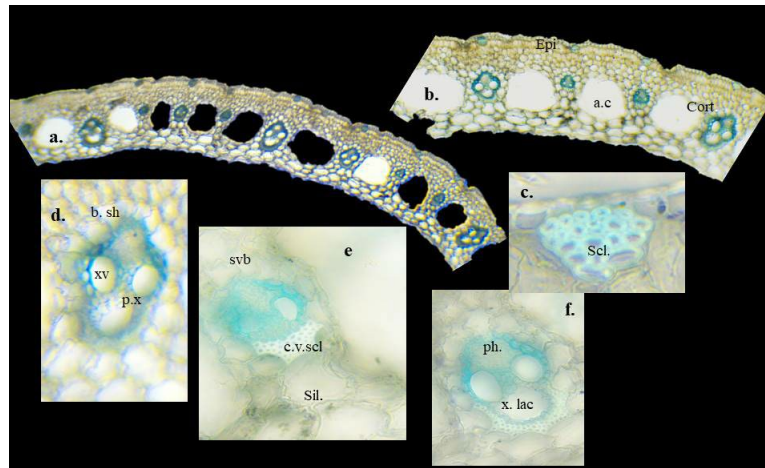


Fig 3: T.S. of Bract *S. praelongata*: a & b. outline showing epidermis cortex, air cavities (a.c) and vascular bundles, c. sclerenchyma bundle (scl.) d&f. large vascular bundles (lvb) & e. differentiated small vascular bundle (svb) with silicified bundle sheath cells (sil.).

T. S. of Culm

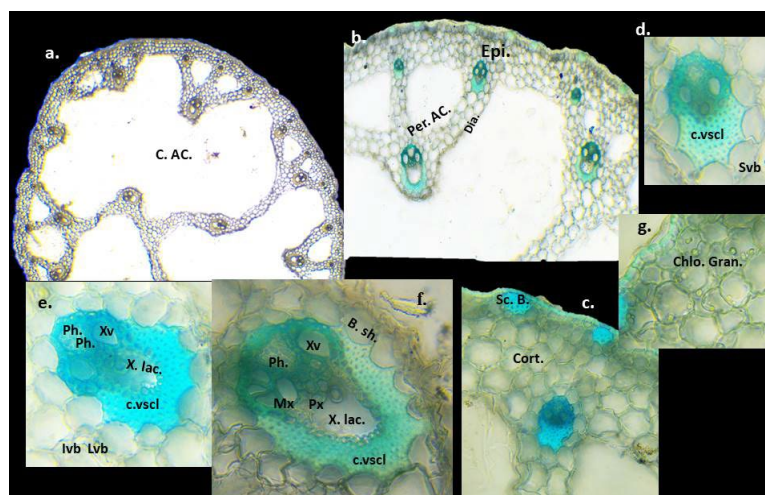


Fig 4: T.S. of culm *S. praelongata*: a-c. General outline showing epidermis (epi) central air cavities (C. AC.), peripheral AC), diaphragm (Dia.) and cortex (Cort.), d-f, differentiated small vascular bundle to large vascular bundles consists of xylem vessels, phloem, xylem lacuna and surrounded by bundle sheath (B.sh.) and circum vascular sclerenchyma (C.Vscl.) and chloroplast granules

Transverse section terete 4 - 4.9 mm, epidermis single layered cuticularized made of thick walled cells. Sclerenchyma bundles many 72.778 μm scattered beneath epidermis. Cortex parenchymatous with or without intercellular spaces. Aerenchyma schizogenously developed categorized into two type's peripheral and central aerenchyma based on position. Peripheral aerenchyma further categorized into 3 types based on size and shape, 10-20 small air cavities 15.55 μm regularly alternating with vascular bundles, 4-5 intermediate air cavities 40.23 μm and 4-5 large air cavities 120 μm . The 3-4 large central air cavities inter connected 170 μm 3-4 lobed. Diaphragm of central air cavities 3-4 cells thick and longer than diaphragm of peripheral air cavities, the cells of air

cavities reticulate. Vascular bundles conjoint collateral closed categorized into 3 types based on size, 8-10 large bundles out of these 4 situated at the middle region of diaphragm of central large air cavities rest alternating with small-intermediate peripheral air cavities traversed by 2-3 cells thick diaphragms and at the base of theses peripheral air cavities. About 10-13 intermediate vascular bundles and 20-22 small differentiated and undifferentiated vascular bundles, small vascular bundles present at the base of cortex and the outer cells of diaphragms are silicified (Fig.4). All the vascular bundles surrounded by comparatively small parenchymatous bundle sheath and large polygonal circumvascular sclerenchyma arc.

T. S. of Leaf Sheath

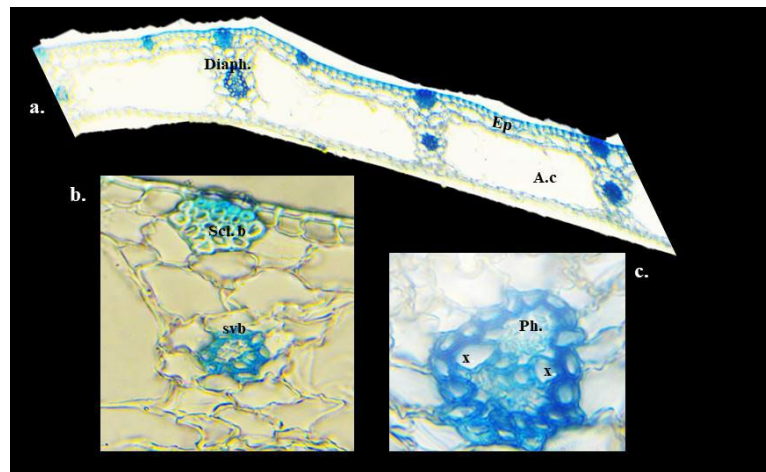


Fig 5: T.S. of Leaf sheath *S. praelongata*: a. Transverse section showing epidermis, sclerenchyma bundles (scl.b), air cavities (AC) and Vascular bundles. b. magnified sclerenchyma bundle and undifferentiated small vascular bundle & c. differentiated vascular bundle showing 1 small xylem element (X) on either side and regular phloem (ph.)

The outline of leaf sheath appears terete in cross section *ca.* 5.8 - 6 mm. the epidermis 1 layer immediately followed by scattered sclerenchyma bundles forming discontinuous hypodermal ring. Sclerenchyma bundles 48-59 vary in shape from crescentiform to pentagonal *ca.* 92.5 μm Cortex aerenchymatous composed of *ca.* 48 flattened rectangular cartwheel aerenchyma developed through schizogenous pattern each air cavity *ca.* 770 μm . The vascular bundles act as diaphragm and regularly alternating with air cavities. Vascular bundles 50-60 categorized into 2 types based on size differentiated vascular bundles 120 μm and undifferentiated bundles 70-80 μm . The xylem elements present on either side *ca.* 25.17 μm in differentiated vascular bundles. The cells of bundle sheath silicified, kranz sheath absent (Fig.5) and central hollow air cavity 4.9 -5.2 mm present.

T. S. of Root & Rhizome

Transverse section of root terete 2.3457 mm. Epidermis single

layer thickly suberized made of uneven elongated cells. Cortex cartwheel aerenchymatous developed through lysogenous pattern and air cavities flattened separated from each other through 1-2 cells thick hexagonal parenchymatous diaphragm. Central stele centrarch protosteles 347.94 μm , xylem medulla at the centre and protoxylem 53.545 μm along with phloem 57.24 μm occupies peripheral region (Fig.6 a & b). Rhizome 5.3 mm terete, epidermis thickly suberized followed by 1 layer sclerenchymatous exodermis. Cortex parenchymatous rich in starch grains and few cortical vascular bundles scattered here and there along with emerging traces of root development, the cortical cells compactly arranged without intercellular spaces. The central stele amphivasal atactostele 3.5mm, the xylem ring *ca.* 330.99 μm and inner phloem 469.386 μm , the large crescentiform to obtuse "V" shaped sclerenchyma bundles underneath of vascular bundles. Clusters of starch grains without hilum present in cortical cells and ground tissue cells of stele (Fig.6 c-f).

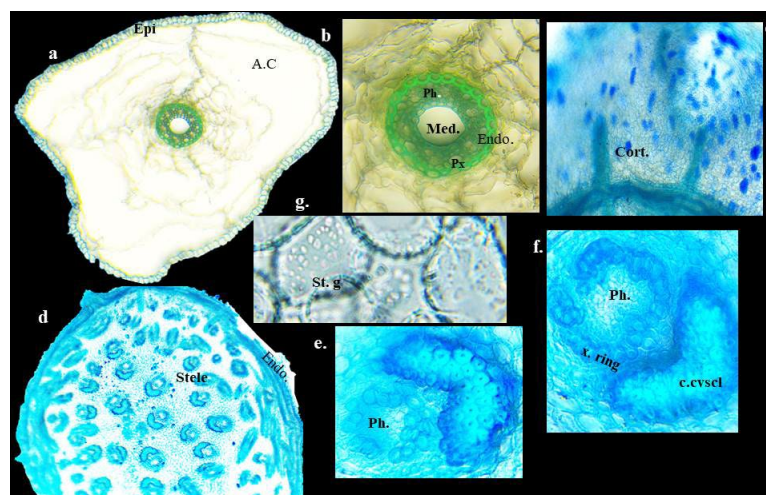


Fig 6: T.S. of Root & Rhizome *S. praelongata*: a&b. T.S. of root and the solitary central stele composed of central medulla (med.), proto xylem (px) and phloem (ph.). c. – g. T.S. of rhizome showing cortex reice in starch graings and central atactostelem, starch grains & vascular bundles surrounded by crescentiform sclerenchyma bundle

Discussions

The *S. praelongata* studied anatomically here exhibit non-kranz anatomy as leaves are reduced to blade less scale like sheaths and the vascular bundles of bract, culms and leaf sheath lacks kranz sheath and vascular bundles separated by

more than 4 chlorenchymatous cells (Fig. 3 d & f, Fig.4 e & f and Fig.5 c). The bundle sheaths surrounding vascular bundles comparatively small and the polygonal circumvascular sclerenchyma thick 4-5 layered and almost surrounding more than half of the length of vascular bundles.

The 4 sub types of vascular bundles occurs in Cyperaceae such as cyperoid, fimbristylloid, eleocharioid and rhynchosporoid in kranz anatomy and differ from each other by the location of chloroplasts, numbers of bundle sheaths and continuation or discontinuation of bundle sheaths (Martins S. & Scatena V., 2011). The vascular bundles in bract, culms, and leaf sheath does not follows any type among these 4 types. Hence, it strictly follows C3 photosynthetic pathway and mestome sheath surrounded by circumvascular sclerenchyma towards xylem lacuna.

In root single layer epidermis present lacking pericycle and casparian strip and single central protostele present whereas, centrarch atactostele present in rhizome where crescentiform sclerenchyma below vascular bundles providing extra mechanical strength to the conducting tissues (Fig.6)

Different types of aerenchyma developed in aquatic and wetland plants by following various developmental patterns such as schizogenous, lysogenous and mixed expansigeny (Jung. J *et al.* 2008). In *S. praelongata* roots formed through tangential lysogeny, cartwheel schizogenous aerenchyma in leaf sheath and mixed aerenchyma including peripheral splitted cartwheel aerenchyma and central large aerenchyma formed in culm formed through schizo-lysogenous pattern and particularly packet lysogeny for peripheral aerenchyma.

Acknowledgement

The authors are grateful to the Mahajyoti a Maharashtra State research fellowship for funding this study.

References

1. Batool R, Hameed M. Root Structural Modifications in Three *Schoenoplectiella* (Reichenb.) Pall. Species for Salt Tolerance (2013). *Pakistan Journal of Botany*. 1969-1974; 45(6).
2. Bryson C, Carter R. The Significance of Cyperaceae as Weeds. *Sedges: Uses, Diversity and Systematics of the Cyperaceae*. 2008; 15-101.
3. Das U, Majumdar S, Ghosh, A, Co-occurrence of Two Bet-hedging Strategies: Pseudo-vivipary and Amphicarp in *Schoenoplectiella praelongata* (poir.) Lye (Cyperaceae). *Nat. Acad. Sci. Lett.* (2025). DOI: 10.1007/S40009-025-01870-5.
4. Johansen D, A. Plant Microtechnique McGraw-Hill Books, New York, 523, 1940.
5. Jung J, Lee S, Choe H, Anatomical patterns of Aerenchyma in Aquatic and Wetland Plants. *Journal of Plant Biology*. 2008; 51(6):428-439.
6. Martins S, Scatena V. Bundle Sheath Ontogeny in Kranz and non-Kranz species of Cyperaceae (Poales) (2011). *Australian Journal of Botany* 59: 554-562.
7. Metcalfe CR. *Anatomy of Monocotyledons: Cyperaceae*. Clarendon Press, Oxford, 1971, 239.
8. Muhammad H, Muattar, Z, Muhammad I, Iftikhar A. Morpho-Anatomical adaptations of *Schoenoplectus lacustris* (L.) Palla along the Salinity Gradients in Sargodha Pakistan (2025). DOI: <https://doi.org/10.21203/rs.3.rs-5741453/v1>.
9. Sayekar H, Ghalme R. Comparative Anatomical Study of Four Species of *Eleocharis* (Cyperaceae) from the Wetlands of Ratnagiri District, Maharashtra. *Journal of Economic and Taxonomic Botany*. 2025; 49(2):63-72.
10. Starr J, R. & Ford, B., A., The taxonomic and phylogenetic utility of vegetative anatomy and fruit epidermal silica bodies in *Carex* section *Phyllostachys* (Cyperaceae). *Canadian Journal of Botany*. 2001; 79(3):362-379.
11. Sudhakar J, Arunmugam S, Murugan C, Murthy G, Cyperaceae of Tamil Nadu. *Botanical Survey of India* 187-191.
12. Wadoodkhan M, A. Cyperaceae of Western Ghats, West Coast and Maharashtra (2015). *Dattsons Publishers* 126-148.
13. Wheeler M, A, Bruhl J, J. Taxonomic Utility and Ecological Significance of Comparative Reproductive Biology in Sedges (Cyperaceae: Schoeneae). *Monocots: Systematics and Evolution*. Eds K. I. Wilson and D. A. Morrison, 2000, 645-649.