

## Stem anatomy of *Calamus henryanus* Becc. from Assam, India

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Received: 15 September 2020 / Accepted: 3 November 2020  
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**Abstract:** The stem anatomy of *Calamus henryanus*, a recently reported rattan from Assam was done. Both transverse and longitudinal sections of the species were studied; the epidermal cells were found similar to two native *Calamus* species viz. *C. kingianus* and *C. leptospadix* of North-east India; a detailed study is provided here.

**Keywords:** *Calamus*, Rattan, Vascular bundles

### Introduction

The genus *Calamus* L. is represented by highest number of around 411 species among the members of the sub family Calamoideae of Arecaeae family, distributed from West Africa to Fiji, from sea level to an elevation of 3350m (Henderson, 2020). Different aspects of anatomical study already proved significant in distinguishing different genera as evidenced by survey of literature. The outline of the stem anatomy of *Calamus* species was provided by Tomlinson (1961). Identification of the stem without leaf sheath is difficult and internal morphology significant for differentiation of rattan genera includes the size and shape of the epidermal cell, number of metaxylem vessels and phloem in the

vascular bundle and ground parenchyma (Ebanyenle and Oteng-Amoako, 2003). Arrangement of the vascular bundles is uniform in *Calamus* stem (Tomlinson, 2006). Numbers of vessels played significant role in classification at sub family level, where, Arecoideae and few Calamoideae represent one vessel, Coryphoideae with two and Ceroxyloideae with three vessels (Thomas and Boura, 2015). In an another study, Mathew and Bhat (1997) reported stem anatomy of total 42 rattan species belongs to four genera i.e. *Calamus*, *Daemonorops*, *Korthalsia* and *Plectocomia* from India and provided biogeography based differences among the groups; in addition, taxonomic keys were also added for identification of rattans distributed in the three major distribution regions of India i.e. Andaman and Nicobar islands, Western Ghats and North-eastern region; out of 42, the study deals with 36 species of *Calamus*. The species *Calamus henryanus* was recently reported rattan from Assam of India, its occurrence recorded up to an elevation of 704m in Cachar district of the State (Mehmud and Roy, 2020) and in the present paper, an attempt is made to study the stem anatomy of *C. henryanus* for the first time from India.

### Materials and Methods

Voucher specimens are deposited at ASSAM (Accession Number 95113 and 95114) and in herbarium of Department of Botany, Cotton University. The preserved stem in formalin was

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washed by running water then transverse and longitudinal free hand sections made with the help of sharp blades; uniform and thin sections were transferred in Petri dishes with distilled water; high quality sections were selected and permanent slides prepared through double staining technique (safranin and fast green), simultaneously passed through alcoholic grades for dehydration and finally mounted in DPX. Slides were observed under camera enabled light microscopes (Lawrence Mayo N300M) under different magnifications such as 10X, 40X and 100X, type and nature of cells studied and their measurements recorded. Anatomical identification and description of the cells and tissues was done using Tomlinson (1961) and Renuka *et al.*, 2010).

## Results and Discussion

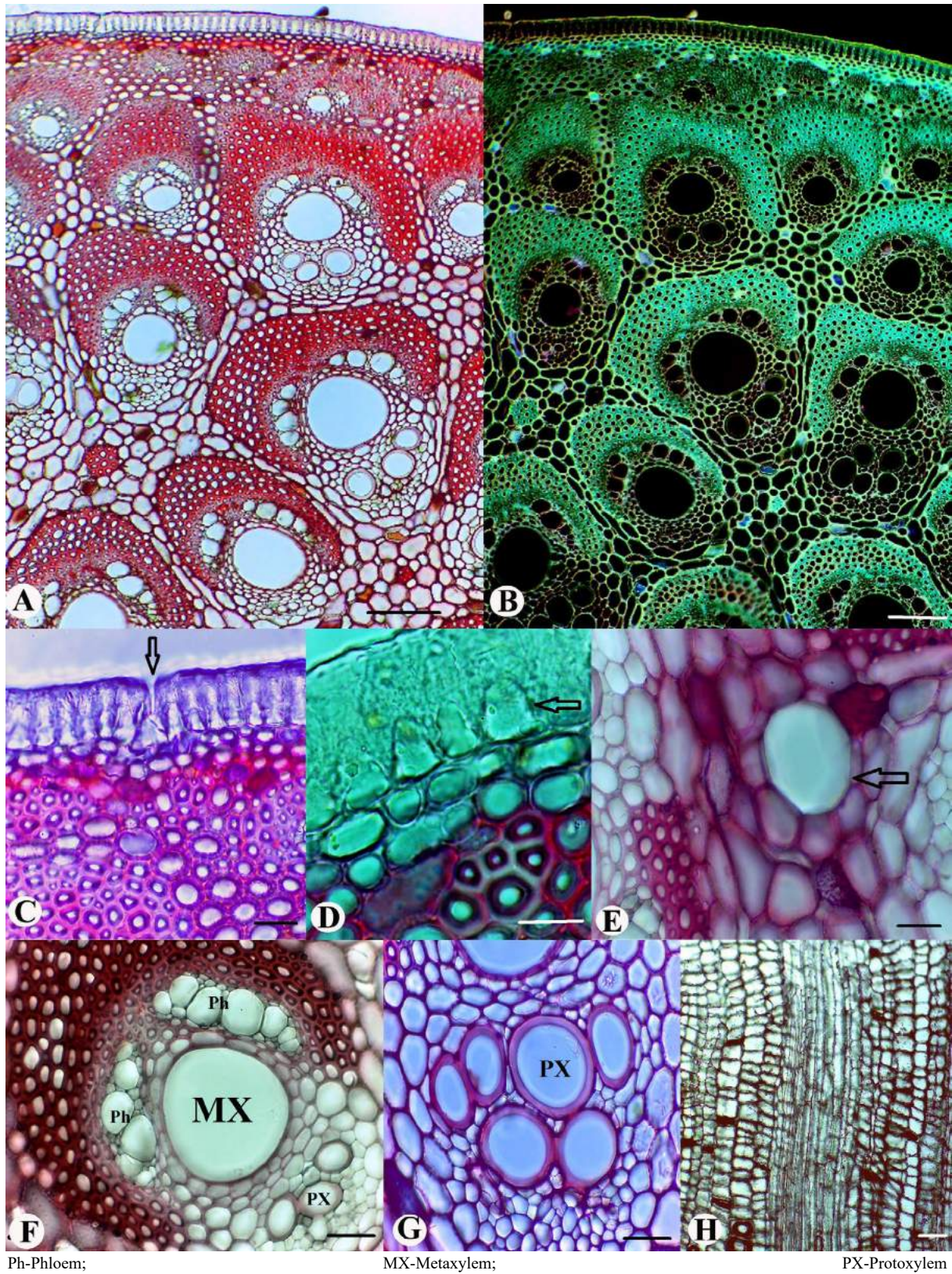
This is a small climbing rattan around 8m long, leaf ecirriate with regular leaflets and habitat in dense forest fig. 1A, stem armed by triangular spines fig. 1B. A detailed anatomical description along with photo plates highlighting the stem outline with distribution of vascular bundles fig. 2 A and B, epidermal cells fig. 2C and D, mucilage cell fig. 2E, images of vascular bundles fig. 2F and G in transverse section and the tissues of the stem in longitudinal sections is provided here fig. 2H.

The stem is circular in transverse section; epidermis is single layered, cells are longitudinal or oblong ca.  $14.3\text{--}16.2 \times 7.7 \mu\text{m}$ , lumen triangular and few stomata observed. Epidermis is followed by two layers of hypodermis which consists of round to ellipsoid thin walled cells ca.  $6.5 \times 3.7 \mu\text{m}$  – ca.  $11.2 \times 4.1 \mu\text{m}$ , without intercellular spaces. Cortex with thick walled lignified parenchymatous cells associated with few complete or incomplete vascular bundles. The number of fibrovascular bundles were more in mid portion of the stem, 12–14 nos. in per  $\text{mm}^2$  and larger than the fibrovascular bundles of periphery. Ground tissue is consists of thin walled round to angular cells ca.  $19.2 \times 10.5 \mu\text{m}$  – ca.  $38.7 \times 15.6 \mu\text{m}$ , intercellular spaces ca.  $9.7 \mu\text{m}$ , few round mucilage cells ca.  $24.4 \times 23.46 \mu\text{m}$  – ca.  $32.84 \times 27.99 \mu\text{m}$  and fiber bundles ca.  $23.2 \times 29.3 \mu\text{m}$  present. Fibrovascular bundles are not uniform in sizes and ranges from ca.  $126.09 \times 120.77 \mu\text{m}$  – ca.  $186.46 \times 150.56 \mu\text{m}$ . Each fibrovascular bundle is with a large ovate or round metaxylem ca.  $51.68 \times 58.93 \mu\text{m}$  – ca.  $80.24 \times 68.50 \mu\text{m}$ ; two kidney shaped phloem strands ca.  $51.62 \mu\text{m}$  long are laterally arranged close to the metaxylem, each strand consists with five to eight or more thin walled sieve elements ca.  $14.78 \times 15.48 \mu\text{m}$  – ca.  $15.52 \times 14.21 \mu\text{m}$ . Protoxylem is of one to six round or ovate thick walled cells ca.  $11.17 \times 12.57 \mu\text{m}$  – ca.  $23.46 \times 26.82 \mu\text{m}$ , situated



**Fig 1.** Habit (A); Cross cut of the stem (B) [scale bar: 1cm]





**Fig 2.** Transverse section of stem of *Calamus henryanus* Becc., (A); Outline of the stem [scale bar: 50  $\mu$ m] (B); Epidermis with stomata (arrow) [scale bar: 10  $\mu$ m] (C); Close up image of epidermal cells with lumen (arrow) [scale bar: 10  $\mu$ m] (D); Inter-vascular cells with mucilage cell (arrow) [scale bar: 10  $\mu$ m] (E); Complete fibrovascular bundle [scale bar: 20  $\mu$ m] (F); Protoxylems [scale bar: 20  $\mu$ m] (G); Cells in longitudinal section of stem [scale bar: 20  $\mu$ m] (H)

below the metaxylem. In longitudinal section, cells ca.  $27.2 \times 20.7 \mu\text{m}$  are appear as rectangular.

## Conclusion

The triangular lumens present in the epidermis of this species are similar to the cells in the diagrams of *Calamus kingianus* and *C. leptospadix* provided by Mathew and Bhat (1997). The size of metaxylem in *C. henryanus* was found comparatively smaller than reported in *C. kingianus* and *C. leptospadix* (Mathew and Bhat, 1997). We Observed both *Calamus henryanus* and *C. leptospadix* is to some extent morphologically similar to each other regarding stem size and leaf with regular leaflets, while the size of the stem is small and leaflets are grouped in *C. kingianus*; all these species are differ in spine armature as *C. henryanus* bears triangular spines but linear in *C. leptopadix* and *C. kingianus*. The similarity of *C. henryanus* and *C. leptospadix* was also reported by many authors (Beccari, 1908; Henderson, 2020) but *C. henryanus* bears long terminal rachilla of partial inflorescence (Henderson, 2020; Mehmod and Roy, 2020). This anatomical study will be helpful in confirming the identity of *C. henryanus*.

## Acknowledgement

We are thankful to the Head of the Department of Botany, Cotton University for providing laboratory facilities; PCCF (WL), Panjabari, Guwahati, Assam; authorities of ASSAM and CAL for herbaria consultation.

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