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PLEUROCARPOUS MOSSES OF BANGLADESH: FAMILY THUIDIACEAE AND BRACHYTHECIACEAE

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Key words: Pleurocarpous mosses, Thuidiaceae, Brachytheciaceae, Hypnobryales, Bangladesh.

Abstract

A taxonomic account of six species of pleurocarpous mosses of Bangladesh under the order Hypnobryales is given. Detailed taxonomic descriptions, illustrations, and distributions of these six species are provided .

Introduction

So far Khatun and Hadiuzzaman (1994,1995,2003,2004,2005) have described 14 genera with 24 species of pleurocarpous mosses of Bangladesh and illustrated them. Earlier, Tixier (1967) studied a large number of hepatics and mosses from the forest of Kaptai in the former district of Chittagong Hill-Tracts (now Rangamati dist.), and the forest of Cox's Bazar and Sitakund hills in the greater Chittagong district and he published only a ckecklist without giving any descriptions and illustrations. In this checklist he reported 15 pleurocarpous mosses from Bangladesh and among these he mentioned only one species from Thuidiaceae family, e.g. *T. meyenianum* from Cox's Bazar and Kaptai. He, however, did not mention anything about *Anomodon* of the same family, and *Homalothecium* and *Brachythecium* of the family Brachytheciaceae. Gangulee (1978) described 4 species of *Anomodon* and 19 species of *Thuidium* from the adjacent West Bengal but did not mention about their occurrence in the present Bangladesh territory except mentioning Tixier's collection of *T. meyenianum.* This shows that very little study has been made on this group of plants, i.e. pleurocarpous mosses in Bangladesh. Therefore, the present work was undertaken to evaluate the whole group of pleurocarpous mosses in Bangladesh and this work is an outcome of that, which includes only the order Hypnobryales. The study reveals that the order Hypnobryales in Bangladesh is represented by two families, namely, Thuidiaceae and Brachytheciaceae. The family Thuidiaceae is represented by two genera, each with a single species, e.g., *Anomodon rostratus* (Hedw.) Schimp. and *Thuidium meyenianum* (Hamp.) Doz. & Molk. ; and the family Brachytheciaceae is also represented by two genera with four species , e.g. *Homalothecium sericeum* (Hedw.) B.S.G. and *Brachythecium salebrosum* (Web. & Mohr.) B.S.G., *B. curtum* (Lindb.) Limpr. and *B. acuminatum* (Hedw.) Aust. The illustrated taxonomic descriptions of these taxa are given below with their ecology and distribution within Bangladesh.

Key to the genera of Thuidiaceae

1. Plant and leaf very small, leaf cells isodiametric, number of paraphyllia present ***Thuidium***
- Plant and leaf large, leaf cells more or less hexagonal, not isodiametric, no paraphyllia ***Anomodon***

Genus ***Thuidium*** B.S.G. in Bryol. Eur., 5 : 157 (1852)

Slender to robust, mostly stiff plants. Stem prostrate, more or less regularly 1-3 pinnate. Paraphyllia numerous. Leaves dimorphic, stem leaves larger, ovate, mostly plicate, long acuminate from cordate base, nerve single, strong. Branch leaves much smaller, mostly ovate-lanceolate, acute, concave, costa single, ceasing well below the apex. Leaf cells isodiametric, incrassate, strongly papillose. Seta long, rough. Capsule horizontal. Peristome double with cilia.

1. Thuidium meyenianum (Hamp.) Doz. & Molk. in Bryol. Jav., **2**: 121 (1865)

Hypnum meyenianum Hamp. in Icon . Musc.: **8** (1844)

Hypnum kuripanum Doz. & Molk. in Zoll. Syst. Verz.: 29 (1855)

Yellow green to brownish, wiry, delicate, plants in dense mats, in naked eye no leaf is seen except stem. Main stem creeping, irregularly, bipinnately branched, branches in one plane, up to 3cm long. Paraphyllia present, simple, filamentous. Leaves dimorphic, stem leaves incurved on drying, erect spreading when moist, larger in size and less in number, distant, triangular, ovate, suddenly narrowed in to a long acumen from a cordate base, plicate, up to 8.0 mm long and 0.2 to 0.3 mm wide. Costa ceasing a little below the apex to percurrent. Branch leaves small, close, erect spreading (somewhat curled and appressed to stem when dry), concave, ovate, with acute point ±0.18 mm long and ±0.15 mm. wide, margin crenulate, flat, costa single, ceasing well below apex. Leaf cells small, obscure with one and more than one papillae, irregularly hexagonal, ±5 to 6 µm wide. Sporophyte on main stem, perichaetial leaf narrow with fine long floxuose acumen, into a denticulate arista, nerve excurrent, without papillae, cells irregularly rounded to rectangular. Seta erect, rough all over with papillae, ± 1.5 mm long, arcuate at top, dark brown in colour. Capsule horizontal, inclined, gibbous, ovate cylindrical, ± 1.5 mm long and ± 0.5 mm in diameter, yellow brown in colour and mildly papillose. Peristome normal, hypnoid. Exostome teeth brownish, lanceolate, densely horizontally stripped below, ± 0.5 mm high, basal membrane high, endostome segments pale, keeled with median perforation slits almost as long as exostome. Cilia one or two, slightly shorter than endostome segments. Mouth cells short, irregularly rounded to quadrate, exothecial cells large, irregularly quadrate to rectangular in shape. Spores rounded, dark brown in colour, ±10 to 15 µm in diameter. (**Fig. 1**)

Specimens examined: **Bhola**:Gazipur road, on the bark of tree, Rokeya Nazmi Tahnia, 07.05.97, **488**; **Chandpur**: Hajiganj, on soil, sanaullah,12.03.97, **770**; **Chittagong**: High

Hill of Bareyadhala, Jesmin Akter, Lulu Bilkis Banu, Mizanur Rahman,11, 03.76, **98**; Kalurhat, on slopy area, on soil, Razia Begum, Parveen Sultana, 13.10.76, **153**; Potiya,on the bark of tree, Anwar Sadat, 23.11.98, **1362**; **Comilla**: Muradnagar, on soil, Yasmin Sultana, 05.04.85, **338**; **Cox's Bazar**: Teknaf, on the bark of tree, Hamida Khatun, 22.02.92, **94**; **Maulvi Bazar**:Srimangal, Magurcherra, on soil, M.S. Islam, 20.11.73, **148**; Burburia, on the bark of tree, Hamida khatun, 23.12.98, **1458**; Lawacherra Forest, on soil,

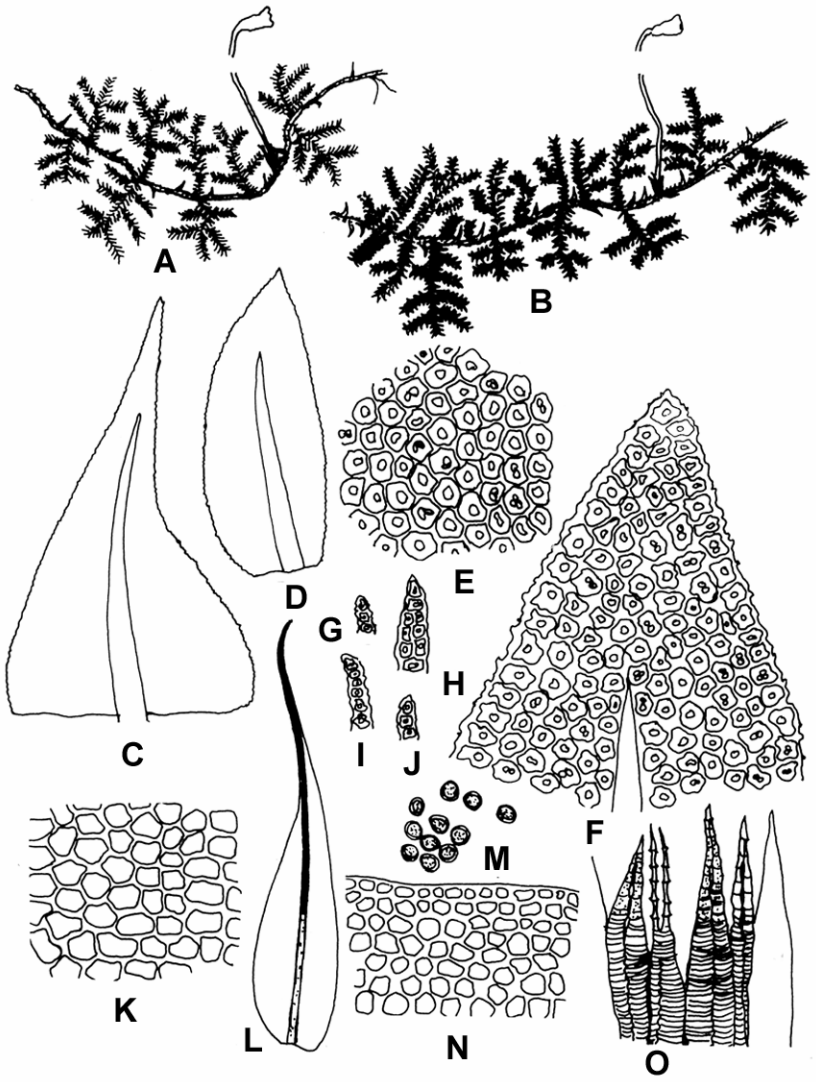

Fig.1. *Thuidium meyenianum* (Hamp.) Doz. & Molk. A. Dry Plant (x6); B.Wet Plant (×6); C. Main stem Leaf (×72); D.Branch stem leaf (×72); E. Middle laminal cell (× 270; F. Apical laminal cells (x 270); G-P araphyllia (x 120); K. Exothecial cells of the capsule (× 120); L. Perichaetial leaf (× 72); M. Spores (× 180); N. Mouth cells of the capsule (× 120); O. Peristome teeth (× 120).

Mizanur Rahman, 22.7.89, **26**; Madhobkundu, on the bark of tree, Salima Begum, Husna Banu, Nilufar Akhtar, Tahmina Begum, 13.03.77, **53**; Lawacherra CNB Road, on the bark of tree, Shafaet Ahmed Khan, 17.10.88, **138**; **Syleht**: Jaflong, on the bark of tree, Rabeya Kabir, 05.09.88, **144**; **Naogaon**: Mohadevpur on soil, Akibuddin,07.01.96, **781**; **Noakhali**: Sreenarayanpur, on the soil, Lutfa Rahman,12.05.75, **125**; **Panchagarh**: Tetulia, Bank of Mohananda river, on soil, Luna Ahmed, 17.01.93, **180**; Ullapara, on the bark of tree, Luna Ahmed, 03.03.94, **282**, Tetulia, Kumibon; on the bark of tree, Hamida Khatun, Md. Yousuf Ali, Monnuzan Begum, Mahbuba Sultana, Sohel Chawdhury, 22.12.98. **146**; **Satkhira**: Kaliganj, on soil,Begum Sultana, 16.09.77, **130**; Shamnagar, on soil, Begum Sultana, 16.09.77, **131**; **Sherpur**: Phulpur, on the bark of tree, Jashim Sheikh, 18.03.75, **52**.

Note: Distinctly very small plant, main stem creeping, secondary stem once, twice or even thrice pinnately branched, branches with paraphyllia, leaves dimorphic, one type is small scale-like and second one is large chlorophyllose. Leaf cells isodiametric, strongly papillose are distinguishing features of this species.

Genus ***Anomodon*** Hook. & Tayl. in Musc. Brit. : 79, 3 (1818)

Dark green, strongly growing lusterless non glossy, fairly stiff and robust, rupestrine or corticolous plants in dense tufts. Main stem creeping , adhering to substratum as they radiculose. Secondary stems simple or two to many branched, paraphyllia lacking. Leaves of secondary stems and branches similar, crowded in numerous rows, imbricate appressed when dry, widely spreading to squarrose when moist, Iance-acuminate from a broad base, oblong or ovate, generally decurrent base, margin papillose-crenulate, costa strong ending below the apex, flexuose, yellow. Leaf cells small, rounded quadrate, pluripapillose. Perichaetial leaves moderately elongate. Seta long , smooth. Capsule erect, oblong-cylindric, symmetrical. Peristome double, cilia missing.

2. Anomodon rostratus (Hedw.) Schimp. Syn . Musc. Eur., P 488, 1840.

Leskea rostrata Hedw., sp. Musc., P.226, 1801.

Plant brown yellow to dark green some times dark brown in dry, become blackish with age, forming dense mats, up to 1.48 × 0.6 cm. Primary stem creeping and radiculous, secondary stems and branches crowded and usually erect. Paraphyllia and pseudoparaphyllia usually none. Leaves of main stem and branches similar,crowded in numerous rows, crowded and imbricate when dry, erect or erect spreading when moist, ovate-lanceolate, acuminate from a broad extreme decurrent base, margin mostly plain, revolute to the base of the acumen. Costa strong, flexuose ending well below the apex. Leaf cells small, hexagonal, thin walled papillose and obscure, cells at the middle of the insertion, oblong, thick walled, smooth and pellucid, rest of the basal cells hexagonal, papillose ± 6.49 × 6.49 µm, basal middle cell ±15 × 3.9 µm, cells at middle upto 9 × 6

μm, tip cell hyaline and hair point in different length, ±21.9 × 3.49 μm, extreme tip cells non papillose. Sporophyte on main stem, and on branch stem, capsule ± 1.5 mm long, oval, oblong cylindric, smooth, becoming dark brown with age, seta upto 10 mm long. Perichaetial leaves pale, elongate, erect, gradually acuminate, smooth, pale elongated cells,ecostate. Peristome pale yellow to yellowish-brown, cross-striolate below, endostome sigments narrow, no cilia. Spores brown, smooth. (**Fig. 2**)

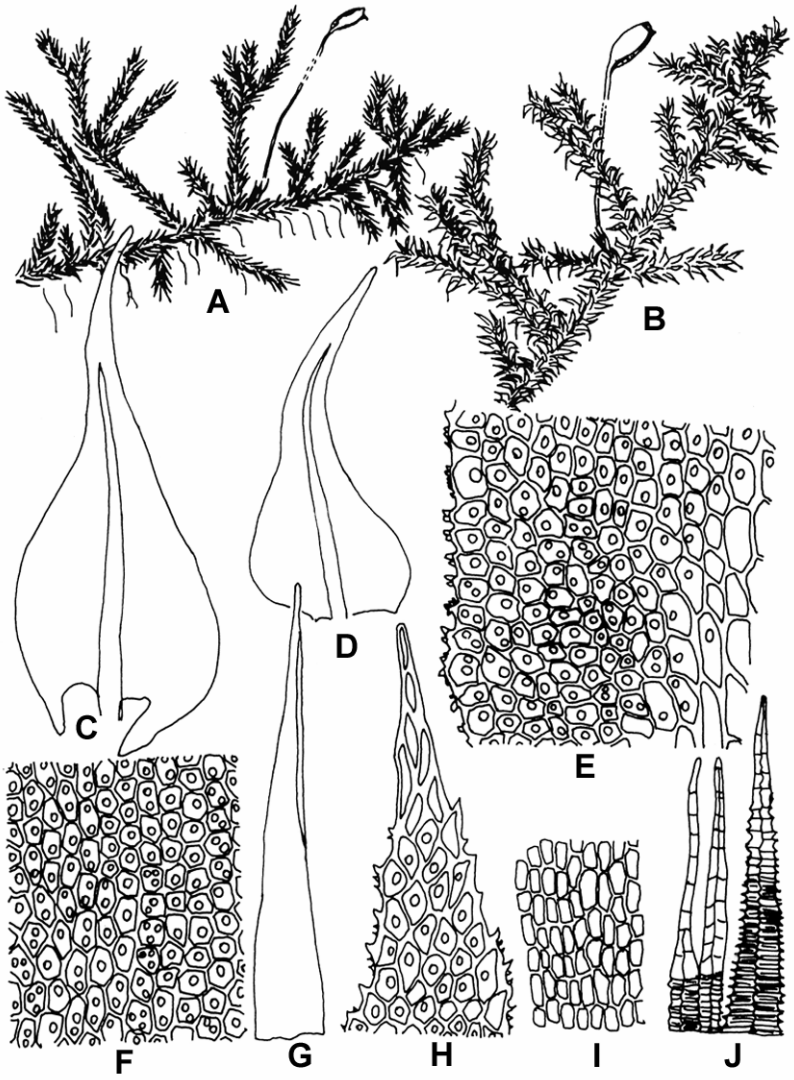

Fig. 2. *Anomodon rostratus* (Hedw.) Schimp. A. dry plant (× 6); B. wet plant (× 6); C,D. leaves (× 22); E. basal laminal cells (× 270); F. middle laminal cells (× 270); G. perichaetial leaf (× 22); H. leaf apex cells (× 270); I. cells of the capsule (× 180); J. peristome teeth (× 36).

Specimen examined : **Jessore**: Jessore Air Base, On the bark of tree base, Hamida Khatun, Shougat Ahmed, 04.04.89; **1064**.

Note: The species is unique in having leaves in five rows, ovate, acuminate, ending in a hyaline hair point of varying length, leaf cells hexagonal, densely papillose.

Key to the genera of Brachytheciaceae:

1. Branches usually curved, ascending when dry, leaves distinctly 2-4 plicate, margins broadly reflexed nearly throughout serrulate at base. Leaves small, lanceolate ***Homalothecium***
- Branches straight, generally horizontal, leaves usually more or less biplicate, margins usually serrulate at above, not more strongly toothed at base ***Brachythecium***

Genus ***Homalothecium*** B. S. G. in Bryol. Eur., 5: 91 (1851)

Moderate dense mats, stems creeping, radiculose with erect branches. Leaves imbricate, longitudinally plicate, lanceolate, finely long acuminate, toothed almost whole leaf, costate for 3/4th of the leaf length, cells linear, almost uniform, Smooth but apices of some of the cells at back near apex upturned as sharp papillae or even spine, alar cells numerous rather quadrate.

3. Homalothecium sericeum (Hedw.) B. S .G. in Bryol. Eur., vol. **5**, 93(1851)

Leskea sericea Hedw in Sp. Musc., 228, (1801)

Hypum sericeum L. ex with. in syst. Arr. Brit. Pl. ed.4, **3**: 846 (1801)

Plants slender, extensive yellow-brown to greenish mats, shiny when dry, stems freely and irregularly branched, with an abundance of erect often curved branches, branches crowded, sub-erect , some what curved when dry, may or may not branches again. Paraphyllia and pseudoparaphyllia not found. Leaves crowded erect to imbricate some times subsecund when dry, erect spreading when moist, upto 1.5 mm long, and 0.21 mm wide, narrowly lanceolate and gradually long-acuminate, somewhat decurrent, strongly 2-4 Plicate, margins broadly reflexed nearly throughout, sinute-serrulate above, serrulate at the base. Costa 3/4th or more the leaf length, often ending in a minute dorsal spine, cells smooth, upper cells linear, flexuose, thick-walled ±25.08 x 5.28 µm, middle cells also long linear flexuose longer than tip cells ±46.2 x 7.4 µm, alar cells small, irregularly sub-quadrate, in small groups, and ±15.2 x 6.6 µm. cell wall not porose. Sporophyte not found. (**Fig. 3**)

Specimens examined: **Gazipur**: Kabirpur, on the bark of tree, Mostaque Ahmed, 27.05.99, **52**; **Pabna** : Raghunathpur, on the bark of tree, Luna Ahmed, 03.03.94, **1614**; **Sylhet**: Golapganj, on the bark of tree, Abu Shahid, 7.12.99, **1531**.

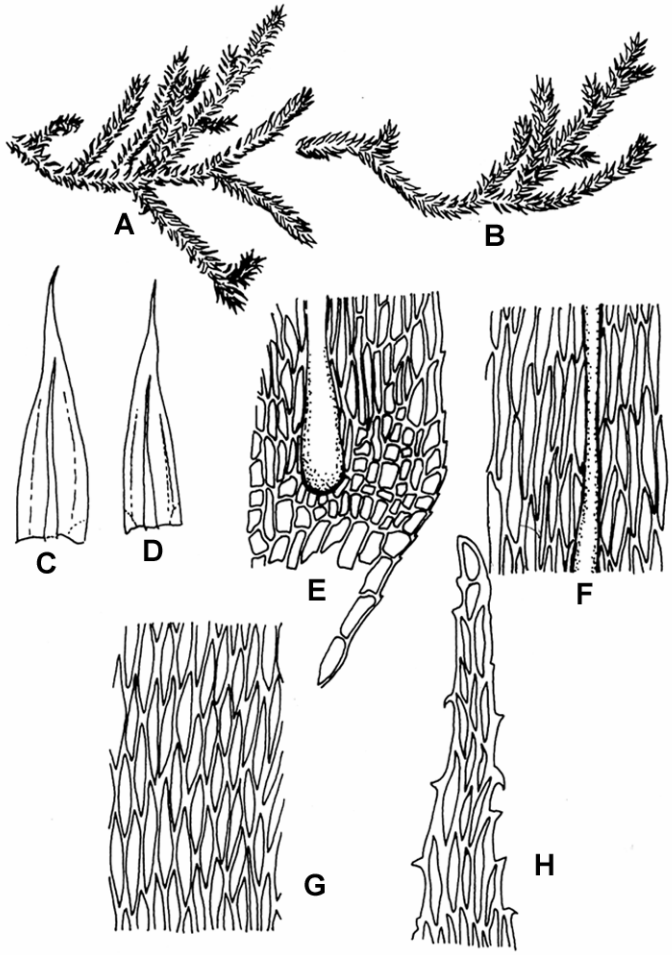

Fig. 3. *Homalothecium sericeum* (Hedw.) B.S.G. A. Dry Plants (x 5); B. Wet Plant (× 5); C, D. Leaves (× 18); E. Basal laminal cells and showing the longitudinal placation (× 150); F. Middle laminal cells (× 150); G. Middle laminal cell at per portion of the leaf (× 150); H. Apical laminal cells (× 150).

Note: This species is very distinct in having plicate leaves, triangular-lanceolate, finely long acuminate, toothed to almost entire, nerve single, strong, reaching 2/3 up the leaf. Some cells near apex upturned as sharp papillae or even spines.

Genus ***Brachythecium*** B.S.G. in Bryol. Eur., 6 : 5 (1853)

Slender to moderately robust plants in mats. Main stem prostrate, ascending to erect, irregularly rarely pinnate branched. Pseudoparaphyllia present. Stem leaves and branch leaves differentiated, loosely imbricate to spreading, often complanate, some times falcato-secund, plicate to plane, mostly concave, decurrent, ovate to ovate-lanceolate or triangular-ovate, acute to acuminate, margin entire to serrulate, nerve single, reaching 3/4

up the leaf, median cells long or short, elongate-rhombic to linear, smooth, alar distinct with quadrate or rectangular cells.

Key to the species of *Brachythecium*

1.	Leaves faintly plicate, Stem leaves narrowly lanceolate (reaching 2.5 × 0.6 mm), gradually and evenly narrowed from base to apex	***B. salebrosum***
-	Leaves not so, stem leaves ovate, more abruptly narrowed to a slender acumination	**2**
2.	Stem leaves with numerous differentiated alar cells extending into rather long decurrencies, leaf tip acuminate	***B. curtum***
-	Alar cells not so, but cells across leaf base uniform in size, leaf-tip abruptly acuiminate, slenderly acute	***B. acuminatum***

4. Brachythecium salebrosum (Web. & Mohr) B.S.G. in Bryol Eur., 6: 20 (1853).

Hypnum plumosum Hedw. ssp. Salebrosum (Web. & Mohr) C. Muell. in Syn., 2: 359 (1851)

Brachythecium laevisetum Kindb. In Bull. Torr. Bot. cl. , 17 : 278 (1890)

Monoecious, plants glossy, yellow-green in mats. Stems up to 5 cm long, creeping and irregularly branching, radiculose, paraphyllia or pseudo-paraphyllia not found. All leaves plicate in dry and wet condition, leaves lanceolate, branch leaves little narrowly lanceolate, reaching ± 2.26 to 2.5 × 0.51 to 0.67 mm. Costa single, covering up to 3/4th or more of the leaf length. Stem leaves and branch leaves about the same shape, but stem leaves little larger in size, gradually and evenly narrowed from the base to the more or less slenderly acuminate apex, reflexed in the lower portion, margin entire, but slightly serrulate at tip, lower margin of leaf slightly reflexed and this reflexed portion is often decurrent and its basal cells different from the median cells, usually sub quadrate, hyaline or slightly chlorophyllose, this band of shorter cells may extend across the entire base of the leaf, the leaf thus constructed usually plicate with narrow longitudinal folds in the central portion. These folds are most conspicuous when the leaves dry, but persist even when the leaves moistened. Leaf cells elongate-rhomboidal to slightly vermiculate ±39.6 x 9.9 µm at tip, middle cells more linear than tip cells ± 54.45 × 7.425 µm, basal cells much broader and shorter ± 24.19 × 10.99 µm. All cells smooth, no papillae, not porous. Sporophyte not found. (**Fig. 4**)

Specimens examined: **Gazipur**: Kabirpur, on the bark of tree, Mostaque Ahmed, 27.05.99, **52**; **Pabna**: Raghunathpur, on the base of tree, Luna Ahmed, 03.03.94, **193**; **Rangpur** : Pirgacha, on the base of tree, Yasmin Sultana, 03.09.84, **194**; Taraganj, on the base of tree, Yasmin Sultana,05.10.85, **195**.

Note: The species is characterized by, in being distinctly plicate, large leaves, gradually and evenly narrowed from base to apex.

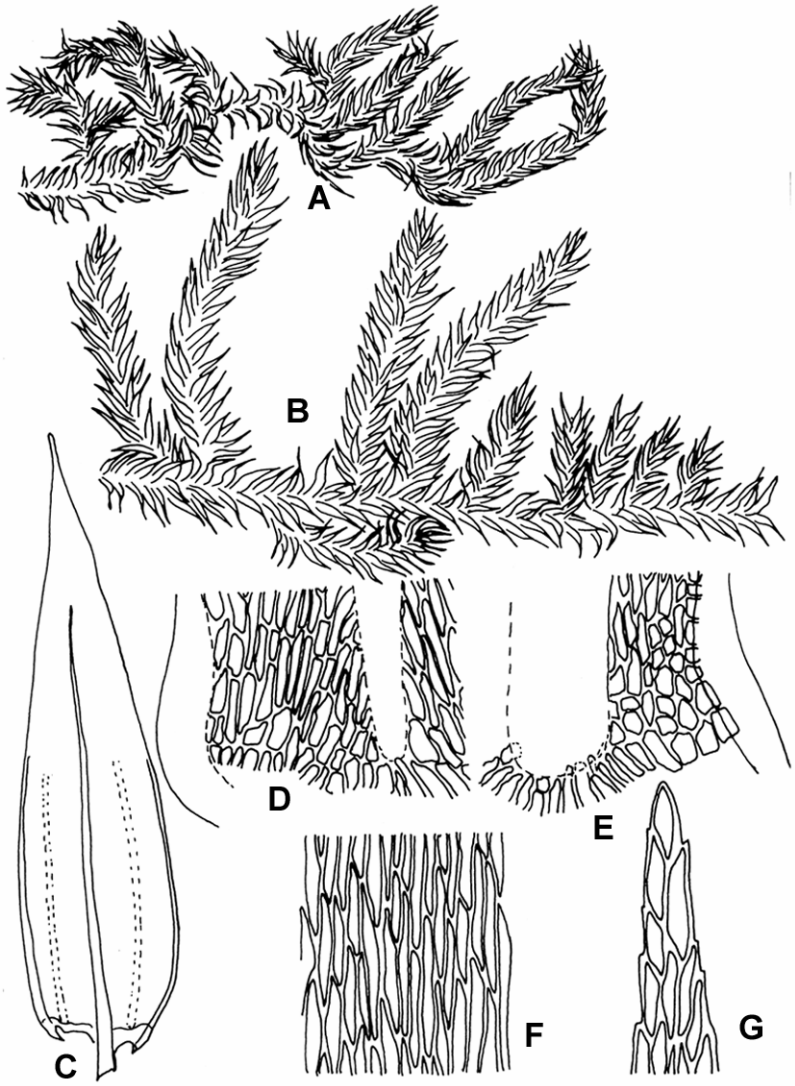

Fig. 4. *Brachythecium salebrosum* (Web. & Mohr) B.S.G. A. Dry Plant (× 6); B.Wet Plant (× 6); C. Leaf (× 6); D. Basal laminal cells at one side of the midrib (× 180); E. Basal laminal cells at other side of the midrib (× 180); F. Middle laminal cells (× 180); G. Leaf apex cells (× 180).

5. Brachythecium curtum (Lindb.) Limpr., Laubm. Deutschl., Vol. 3, P. 101, 1896

Hypnum curtum Lindb., Musci Scand., P. 35, 1879

Autoecious, medium sized plants, in loose, green to yellowish green, shiny mats. Stem ascending, irregularly branched. Stem leaves ovate- lanceolate, acuminate, decurrent or nerve ceasing below apex, ±1.20 mm × 0.64 mm . Leaf cells smooth numerous lax, oblong, cells at the basal angle upto 18.15 × 8.25 μm, middle cells liner

flexuose up to 44.1 × 4.7µm, tip cells are little shorter than middle cells upto 30.87 × 7.35 µm. Branch leaves are not so crowded, spreading and loosely complanate in wet, slightly concave, upto 1.07 mm long, 0.4 mm wide, oblong-lanceolate, gradually acuminate, slightly decurrent , margin plane. Sharply serrulate or, more often, serrate nearly all around except extreme basal portion in branch leaves, costa slender, about 5/6th of the leaf length, Cells linear-flexuose, a few at the basal angles lax, oblong and sub-quadrate. Sporophyte not found. (**Figs. 5-6**)

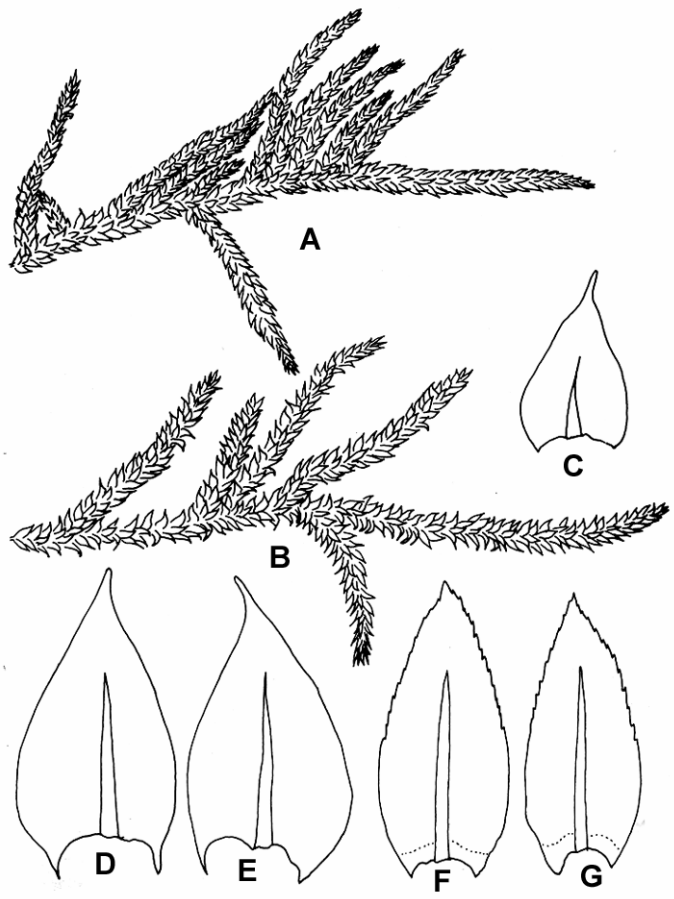

Fig. 5. *Brachythecium curtum* (Lindb.) Limpr. A. Dry Plant (× 5); B. Wet Plant (× 5); C-E. Stem leaves (× 18); F, G. Branch leaves (× 18).

Specimens examined: **Comilla**: Muradnager, on the base of tree, Yasmin Sultana, 05.04.85, **196**; **Faridpur**: Pangsha, on the bark of tree, Begum Sultana, 05.04.97, **219**; **Khulna**: Sundarban, on the bark of tree, Tahamina Khatun, Fahmina Islam, Gita Chakma, Tahmina Shobnom, Rafique 01.01.95, 227; **Maulvi Bazar**: Srimangal, Kaliti Tea Estate,

on the bark of tree, Selima Begum, Nilufar Akter, Husne Ara, Tahmina , 10.03.79, **470**; **Mymensingh**: Ranikhony, on moist soil, S, Gomes, S. Naznin, Selina Banu, 26.5.73, **159**; **Noakhali**: Laxmipur, Suraya Begum, on the bark of tree, 05.01.85, **198**; **Pabna:** Nagarbarighat, on the bark of tree, Luna Ahmed, 03.03.94, **189**; **Satkhira**: on the bark of tree, Naila Morium, Rafia Musarrat, Farida Rahman, Nasheta Zarin, Rafia Afroz. 19.01.95, **467**.

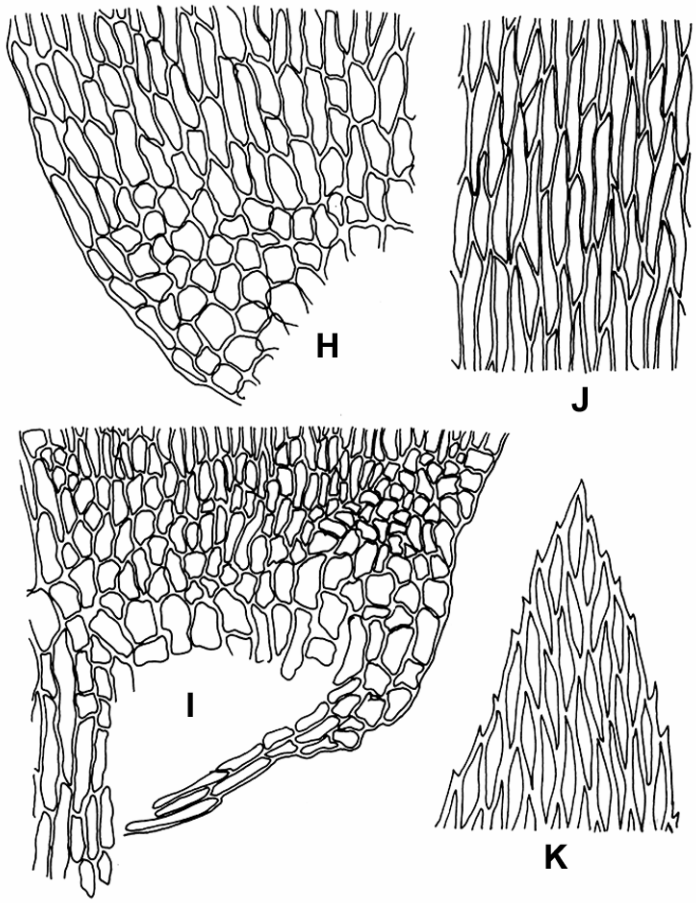

Fig. 6. *Brachythecium curtum* (Lindb.) Limpr. H. Basal laminal cells at one side of the midrib (× 150); I. Basal laminal cells at other side of the midrib (× 150); J. Middle laminal cell (× 150); K. Apical laminal cells (× 150).

Note: Stem leaves broadly ovate-lanceolate and abruptly passing into a short acumen. Stem leaves with numerous differentiated alar cells extending into rather long decurrencies differentiates this species from *B. salebrosum* and *B. acuminatum*.

6. Brachythcium acuminatum (Hedw.) Aust., Musci Appal. no.310, 1870.
Leskea acuminata Hedw., sp. Musc., P. 224, 1801
Hypnum erectum Hook. ex Drumm., Musci Amer. (Rocky Mts.) no. 224, 1828.

Plant green to light green, Shiny plants in mat. Main stems creeping, closely branched, branches erect, short, terete and usually subjulaceous when dry . Stem and branch leaves similar but stem leaves are more wider then branch leaves. Leaves usually crowded, erect when dry, erect spreading or spreading when moist, some what plicate or sometime nearly smooth, ±1.5 to 2 mm long, ovate or ovate-lanceolate, gradually aciminate, slenderly acute, often twisted at the apex, sometimes margins reflexed below, serrulate in the upper half, costa 3/4th of the leaf length, upper cells linear rhomboidal upto 34.65 to 8.25 µ, Shorter at the apex of the leaf upto 31.35 to 7.42 µ. Basal and alar cells sub quadrate in several rows up to ±14.52 to 9.24 µ . (**Figs. 7-8**)

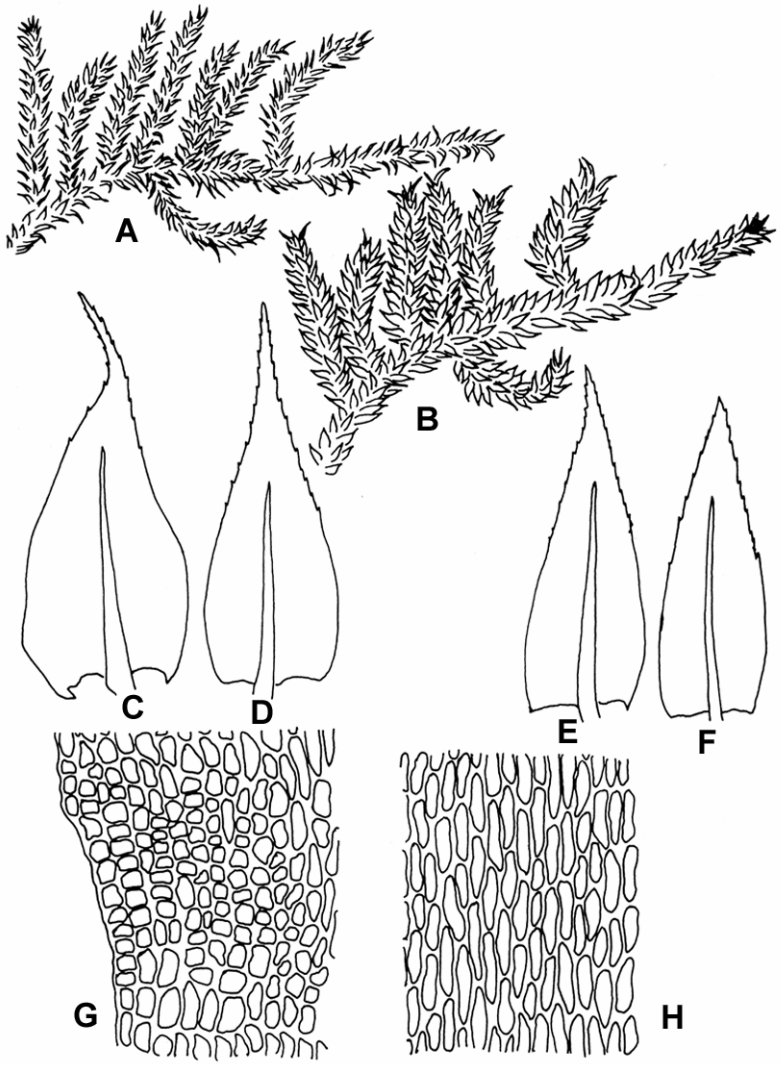

Fig. 7. *Brachythecium acuminatum* (Hedw.) Aust A. Dry plant (× 6); B. Wet plant (× 6); C, D. Stem leaves (× 22); E, F. Branch leaves (× 22); G. Basal laminal cells (× 180); H. Middle laminal cell (× 180).

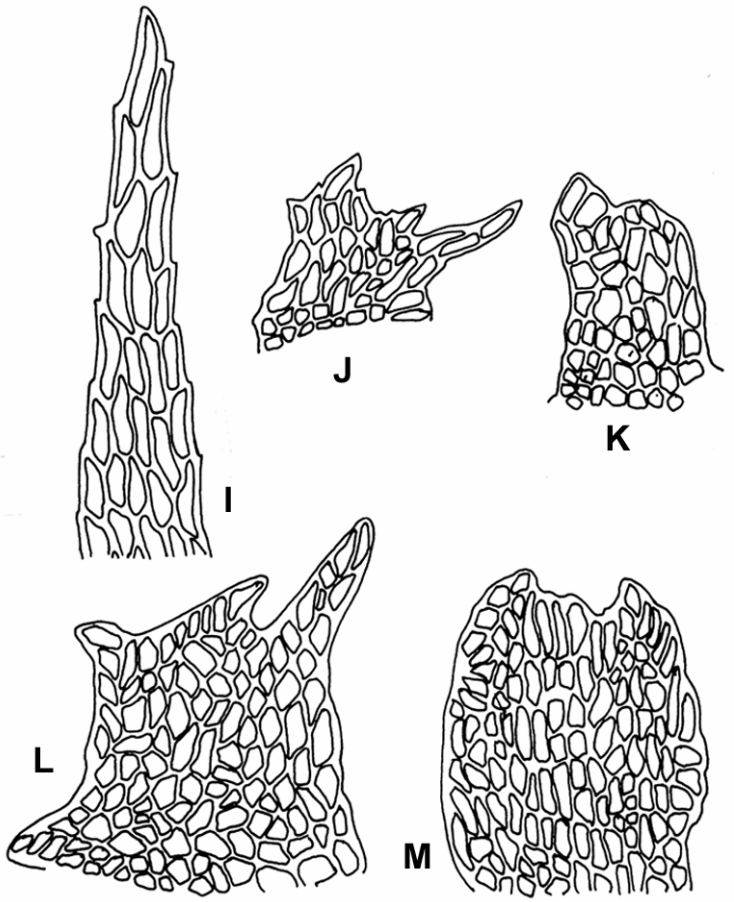

Fig. 8. *Brachythecium acuminatum* (Hedw.) Aust I. Leaf apex cells (× 150); J-M. Paraphyllia (× 150).

Specimens examined: **Bogra:** Bogra Cantonment, on tree base, Hamida Khatun, 2012.89,**197**; **Norsingdi**: Nabinagar, on the bark of tree, Aklima Begum, 04.03.85, **199.**

Note: The species differs from *B. curtum,* in having stem leaves ovate-lanceolate but gradually acuminate, often twisted at the apex. Branch leaves lanceolate and serrulate in the upper half, cells elongated rhomboid.

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