OBSERVATIONS AND RESULT

The mosses which are taken for study belong to order Pottiales. The morphological and anatomical details of these plants have already been studied in detail by past workers hence only a brief account on their general characteristics and morphology is given here.

Order- Pottiales M. Fleisch

Plants grow in dense tufts. Erect, simple to forked stems. Leaves in several ranks; upper cells isodiametric, small, thick walled, papillose; basal cells elongated, hyaline. Erect and long seta; capsule erect, symmetrical; peristome (if present) in single row.


Generally, plants are medium to small-sized growing in dense tufts with erect stems, simple or forked. Single celled leaves arranged in rows; upper cells of leaves are isodiametric, thick walled, small, basal cells are elongated. Sporophytes with erect and long seta and erect capsule with single row of peristome teeth.

This family is further subdivided in subfamilies. A key of the subfamilies is as follows:

Key for the Sub-Families of Pottiaceae (Chaudhary & Deora, 2001)

1. Leaves with wavy or flat margin with oval to lanceolate form, leaf base small or differentiated, operculum longer than urn, sporophyte on smaller side branches. Usually, peristome is absent.......................................................... Eucladioideae

2. Leaves lanceolate with rarely differentiated leaf base. Lamina cells with papillae on them. Peristome erect or spirally wound.................................Barbuloideae

3. Leaves are generally narrow lanceolate types with smaller lamina cells and flat or upwardly enrolled margin. Splitted and long teeth type peristome.............. Trichostomoideae

4. Leaves usually lingulate to spathulate. Costa with extended stereide band. Lamina cells large and papillose................................................................. Pottioideae

Sub-Family Eucladioideae Chen in Hedwigia, 80: 141–322 (1941)


Yellowish-green plants growing in dense tufts on rocky surfaces with dichotomously branched stem densely covered with leaves. Narrow leaves curled (dry), erect (moist), wide at base with flat margins. Costa very short excurrent. Smaller upper lamina cells; basal cells are rectangular and smooth around costa.
A. *Anoectangium clarum* Mitt. in Musc. Ind. Or.: 31 (1859)

(Photoplate 4.1; Figs. A-J)

**Description of plant** - Pale green slender (sometimes stout) plants. Stem branched, up to 1 cm long, covered with erect leaves, spaced by in-between growing rhizoids. Leaves are lightly curled inwardly, up to 2 mm long, 3 mm wide at base and are flattened down to stem when dry, lanceolate, acute apex, smooth margin. Costa prominent, extending towards apex. Basal lamina cells are rectangular and upper cells are irregularly quadrate or ovate.

**Habitat** - Usually growing in shady places with moist soil and rock surfaces.

**Sexuality** - Dioicous (Gangulee, 1969-1980).

**Specimen examined** - Rajasthan- Mt. Abu (near Nakki lake); altitude 1160 m; dated- Aug, 2013; Leg.- A. Bishnoi; Det.- A. Alam; Specimen examined: BURI-7860239/13.

**Distribution in the world** - Myanmar, China, Korea, Japan, India (Gangulee, Gangulee, 1969-1980).

**Distribution in India** - Mussoorie, Nainital, Western Himalaya (Garhwal, Kumaon), Kangra, Punjab, Rajasthan (Gangulee, 1969-1980; Alam et al., 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.2; Figs. 1-4)

Extracts of *Anoectangium clarum* were found more responsive against *S. aureus* with ZOI ranging up to 8-20 mm in comparison to other 3 bacteria with their ZOI varying from 2-12 mm. Observed activity was least in case of *E. coli*.

**Antifungal activity** (Photoplate 4.3; Fig. 5-9)

Plant extracts were less active for *B. cinerea* and *M. phaseolina* whereas, fairly responsive against the other 3 fungal strains.
B. *Anoectangium stracheyanum* Mitt. in Musc. Ind. Or.: 31 (1859)

(Photoplate 4.4; Figs. A-F)

**Description of plant**- Yellow- green, dichotomously branched plants. Pale yellow stem densely covered with specific type of leaves. Leaves are curled when dry, up to 1-2mm long, 1mm wide at base, lanceolate, acute sharp apex, unbroken margin. Prominent costa, brown, extends into a minute tip point. Basal cells of leaf are irregular, rectangular, smaller towards margin from costa, upper cells are irregular, quadrate.

**Habitat**- Grows in moist and shady places with rocky and sandy surface.

**Sexuality**- Dioicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Mt. Abu (near and around Nakki lake), altitude 1160m; dated- Aug. 2013; Leg.- A. Bishnoi; Det.- A. Alam; Specimen examined: BURI-7860232/13.

**Distribution in the world**- Burma, China, Vietnam, Japan, Myanmar, India (Gangulee, 1969-1980; Choudhary & Deora 2001).

**Distribution in India**- East Nepal, Western Himalayas, Darjeeling, South India, Kashmir, Rajasthan (Gangulee, 1969-1980; Alam et al., 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.5; Figs. 10-13)

*Anoectangium stracheyanum*’s ZOI data showed that the extracts were fairly active against all the 4 bacterial strains with still less responsive against *B. subtilis* with less variation in ZOI range.

**Antifungal Activity** (Photoplate 4.6; Figs. 14-18)

The plant extracts were found active only against *F. solani* and *T. viride* but not for the other 3 fungal species.

Plants similar to *Anoectangium* but more studier, thick green or blue-green tufts. Dioicous plants, stems are dichotomously branched and brittle. Leaves are awl-shaped from base surrounding stem, erect, stiff or curled when dry. Strong costa with median deuter. Leaf at the base are light in colour due to less chlorophyll, narrow rectangular, multiple papilla, upper cells are quadrate. Sporophytes on lateral shoots with long setae. Egg shaped capsule.

A. *Molendoa roylei* (Mitt.) Broth. in Nat. Pfl., 1(3): 391 (1902)

(Photoplate 4.7; Figs. A-H)

**Description of plant**- Stout, 1-1.5cm long, dichotomously branched plants, with stem densely surrounded by patent erect leaves. Leaves are falcate or hook-like curved, upto 4mm. long, 0.3mm wide at base and stiff when dry, may be awl shaped with broad base. Upper leaves are longer than lower leaves with acute apex and getting wider at mid-lamina. Base cells of leaves are rectangular near midrib and are smaller near margins, upper cells are somewhat quadrate and papillate and cells near margins are flat. Sporophyte observed to be on short lateral shoots.

**Habitat**- On vertical surfaces of calcareous boulders and cliffs, on damp, shaded roadside banks, occasionally on rotting logs.

**Sexuality**- Dioicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Sawai Madhopur (Ranthambore National Park), alt.- 215-550m; dated- Sept. 2013; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI-7860219/13.

**Distribution in the world**- China, Nepal, Vietnam, India (Gangulee, 1969-1980).

**Distribution in India**- Western Ghats, Western Himalaya, Rajasthan (Gangulee, 1969-1980; Alam, 2012b; Alam et al., 2012c; 2013b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.8; Figs. 19-22)

*Molendoa roylei* extracts were found significantly active against *Enterobacter* spp. and *E. coli* with high variation of ZOI from 10-23 mm.

**Antifungal Activity** (Photoplate 4.9; Figs. 23-27)

Plant extracts were found fairly active against *F. solani* but less active against *A. niger* and *T. viride* and least active against *B. cinerea* and *M. phaseolina.*

(Photoplate 4.10; Figs. A-H)

**Description of plant**- Dark to light green, branched plants growing in dense tufts. Stems upto 4.0cm in height reddish-brown, densely arranged leaves. Leaves adpressed to the stem, incurved, twisted, tubulose when dry, spreading to spreading-recurved when moist, oval, oblong, linear-lanceolate, 1.0-4.0mm long; broadly rounded acute apex; base elliptical; margins flat sometimes denticulate. Percurrent costa, occasionally excurrent. Upper lamina cells usually quadrate, also sometimes subquadrate to rectangular, papillose; basal cells rectangular, cells are smooth, shorter rectangular near costa and margins.

**Habitat**- On rocks, gypsum beds, cave walls, limestone, dolomite, travertine, soil bank, sand, tree, in dry to moist, exposed to shaded places.

**Sexuality**- Dioicous (Zander, 1977).

**Specimen examined**- Rajasthan- Sawai Madhopur (Ranthambore National Park), alt.- 215-550m; dated- Sept. 2013; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860209/13.

**Distribution in the world**- Found on all continents except Australia and Antarctica (Zander, 1977).

**Distribution in India**- Western Himalayas, Kumaon, Munsiyari (Alam, 2015).

**Antibacterial Activity** (Photoplate 4.11; Figs. 28-31)

Extracts of *Molendoa sendtneriana* showed higher values of ZOI against *B. subtilis* and *S. aureus* than *Enterobacter* spp. and *E. coli*.

**Antifungal Activity** (Photoplate 4.12; Figs. 32-36)

Extracts exhibited noticeable ZOI values ranging from 5-20 mm and 3-19 mm respectively against *F. solani* followed by *A. niger* and *T. viride*. 

Dense caespitose, calcicole rock mosses, dioicous. Leaves are linearly lanceolate, carinate with flat margins and blunt apex. Prominent costa that ends before tip. Basal leaf cells are yellowish, rectangular; upper cells are quadrate, rounded, papilla on both sides.

A. Gymnostomum calcareum Nees & Hornsch. in Bryol. Germ., 1: 153 (1823)

(Photoplate 4.13; Figs. A-H)

Description of plant- Small, green, caespitose plants generally on limestone rocks. Red-brown stem upto 3mm long, usually branched, longer leaves on top and shorter leaves at lower side. Leaves are very small (ca.1mm), about 0.1mm broad at base, erect and recurved when moist, ligulate; hanging on stem and shrunk but not so curled when dry. Subacute to round apex, but most blunt as compared to Anoectangium or Hymenostylium with flat margins. Strong costa, red-brown, ends before the tip i.e. below apex of leaf, rough on back. Brown leaf cells; upper cells are irregular, quadrate, with papilla.

Habitat- On soil, soil over rocks and rock faces, on trees, and limestone cliffs.

Sexuality- Dioicous (Gangulee, 1969-1980).

Specimen examined- Rajasthan- Mt. Abu (around Nakki lake and Guru Shikhar), altitude 1160m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860105/14.

Distribution in the world- Europe, New Zealand, Western Tibet, North & South Africa, China, North & South America, India (Gangulee, 1969-1980).

Distribution in India- Eastern and Western Himalayas, Rajasthan (Alam, 2015).

Antibacterial Activity (Photoplate 4.14; Figs. 37-40)

Gymnostomum calcareum extracts were found noticeably active against E. coli and S. aureus with high variation in ZOI values.

Antifungal Activity (Photoplate 4.15; Figs. 41-45)

The activity was observable only against T. viride but it was fairly active against A. niger and F. solani.
IV. *Hymenostylium* Brid. in Bryol. Univ., 2: 81 Suppl. 3 (1827)

Rupestrine, slender, calcicole and tufted plants. Stem triangular without central strand. Leaves are curled when dry. Costa usually ending below the apex. Basal cells smooth rectangular; upper cells sub-quadrate, with papilla.

A. *Hymenostylium recurvirostre* (Hedw.) Dix. in Rev. Bryol. Lichenol., 6: 96 (1933)

(Photoplate 4.16; Figs. A-H)

**Description of plant**- Green, slender plants growing in dense tufts on rocks. Yellow-green stem, radiculose, branched by innovations, up to 6mm long, covered with dense erect to spreading leaves, recurved when moist and flexuose when dry. Leaves upto 1.6mm long, acuminate, carinate concave, 0.2mm wide at base, usually flat with smooth margins. Prominent costa, rough on back, ending below apex. Leaf cells are rectangular and pellucid at base near costa; smaller towards margin but near basal margin cells are narrow, elongated, pellucid; upper leaf cells are subquadrate with distinct and small papilla. Sporophyte not seen.

**Habitat**- On seeping and dripping limestone cliffs or calcareous boulders, often in or near waterfalls.

**Sexuality**- Dioicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Mount Abu (around Nakki lake and Sunset point), altitude 1160m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860238/14.

**Distribution in the world**- Burma, China, Australia, New Zealand, Japan, Korea, Afghanistan, Tajikistan, Western Tibet, Europe (including Great Britain), Philippines, Central Asia, India (Gangulee, 1969-1980).

**Distribution in India**- Kashmir, South India, Western Himalaya, Punjab, Delhi, Rajasthan (Alam et al., 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.17; Figs. 46-49)

For *E. coli* and *Enterobacter* spp., *Hymenostylium recurvirostre* extracts were found fairly reactive with ZOI varying from 5-21 mm.

**Antifungal Activity** (Photoplate 4.18; Figs. 50-54)

The highest value of ZOI was recorded against *F. solani* followed by *A. niger* and *T. viride*. 

V. Hyophila Brid. in Bryol. Univ., 1: 760 (1827)

Small to medium plants, dioicous, growing in dense low mats, usually on rocks or bricks. Leaves inrolled when dry, spatulate or oblong-lingulate, obtuse apex, flat when moist, may be toothed at apex. Strong costa, ending before the tip of leaf or percurrent, rarely short excurrent. Basal lamina cells are rectangular, hyaline; upper cells small, papillose. Perichaetial leaves are usually smaller so are not differentiated sometimes. Apical seta, erect, slender, long. Erect, cylindrical capsule. Peristome absent.


(Photoplate 4.19; Figs. A-H)

Description of plant- Dark green plants in dense tufts. Both antheridial and archegonial shoots apical. Erect, simple or branched shoots from a long, horizontal, radiculose part below, upto about 1 cm high with the top leaves spreading in rosettes. Shoot is uniformly covered with erect-spreading leaves which are curled circinately with the margins inrolled when dry. Leaves are upto 3mm long and 1mm wide, oblong-lingulate, carinate; apex broadly pointed; margin rolled dry, flat and wavy when moist, sometimes denticulate at apex. Prominent reddish-brown costa, wide at base and narrow towards apex, percurrent. Upper lamina cells mamillose, rounded-quadrate, cells are larger towards margin; basal cells are rectangular, cells become smaller above.

Habitat- Generally on moist rocks covered with sandy soil or on walls, or on rocks near any water body or any exposed moist soil may be in association with Semibarbula and Plagiochasma and Funaria spp.

Sexuality- Dioicous (Gangulee, 1969-1980).

Specimen examined- Rajasthan- Tonk (Banasthali) (around Department of Bioscience and Biotechnology premises, Banasthali University), alt.- 320m; dated- Sept. 2014; leg. A. Bishnoi; det.- A. Alam; Specimen examined: BURI 7860209/14.

Distribution in the world- Sri Lanka, Burma, North & South Vietnam, East China, Manchuria, Korea, Japan, Taiwan, Philippines, Indonesia, Celebs, New Guinea, Europe, Sumatra, India (Choudhary & Deora 2001).

Distribution in India- Sikkim, Darjeeling, Odisha, Upper Assam, Arunachal Pradesh, Western Himalaya, Madhya Pradesh, South India, Rajasthan (Choudhary & Deora 2001; Alam et al., 2014a; 2014b; Alam, 2015).

Antibacterial Activity (Photoplate 4.20; Figs. 55-58)
Extracts were found highly active against S. aureus and B. subtilis with ZOI values varying from 6-24 mm.

Antifungal Activity (Photoplate 4.21; Figs. 59-63)
Fairly active against T. viride only with ZOI values ranging between 5-17 mm.
**B. Hyophila rosea** Williams in Bull. N.Y. Bot. Gard., 8: 341 (1914)

(Photoplate 4.22; Figs. A-H)

**Description of plant**- Simple green plants sometimes branched upto 1.5-2cm long. Leaves in rosette tufts with erect to spreading leaves, in-rolled when dry, spathulate from a narrow base, upto 600µm long and 400µm wide, carinate, apex broadly acuminate, involute margins not denticulate. Brown costa, percurrent. Upper lamina cells multipapillose, hexagonal to rounded; base cells are rectangular getting smaller towards top and margins. Erect, apical seta, light brown to yellow-green. Capsule brown, erect, cylindrical with wide base with beaked operculum, sometimes bent to one side. No peristome.

**Habitat**- On mortar, rocks and rarely on soil.

**Sexuality**- Dioicus (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Tonk (Banasthali) (around Department of Bioscience and Biotechnology premises, Banasthali University), alt.- 320m; dated- Sept. 2014; leg.- A. Bishnoi; det.- A. Alam; Specimen examined: BURI 7860225/14.

**Distribution in the world**- Philippines, Malaysia, Mexico, India (Choudhary & Deora 2001).

**Distribution in India**- South India, Gujarat, Odisha, Western Himalaya (Garhwal, Kumaon), Punjab, Rajasthan (Gangulee, 1969-1980; Choudhary & Deora 2001; Alam et al., 2014a; 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.23; Figs. 64-67)

*Hyophila rosea* exhibited noticeable activity against all the 4 bacterial strains with quality range of ZOI values. Observed activity was still somewhat less against *B. subtilis*.

**Antifungal Activity** (Photoplate 4.24; Figs. 68-72)

Perceptible activity was reported only against *T. viride* and *F. solani* with moderate variation in ZOI values.

(Photoplate 4.25; Figs. A-J)

**Description of plant**- Tufted green plants growing on siliceous rocks. Erect, unbranched, fertile plants are of up to 5mm length and sterile ones are much longer. Leaves are erectopatent, curled, pressed to stem and in rolled when dry, spathulate from a narrower and short base, carinate and are up to 2.3mm long; apex acute and pointed; entirely flat margins. Reddish-brown prominent costa, percurrent. Upper lamina cells rounded-quadrate, mamilllose. Basal cells are rectangular, transparent, Erect, apical seta of reddish brown colour. Capsule cylindrical, tapering towards tip, conical operculum. No peristome.

**Habitat**- Mostly on bare moist rocks or sandy moist rocks or old moist walls or calcareous rocks.

**Sexuality**- Dioicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Tonk (Banasthali) (around Department of Bioscience and Biotechnology premises, Banasthali University), alt.- 320m; dated- Sept. 2014; leg.- A. Bishnoi; det.- A. Alam; Specimen examined: BURI 7860202/14.

**Distribution in the world**- Sri Lanka, China, Japan, Nepal, India (Gangulee, 1969-1980).

**Distribution in India**- East Nepal, Darjeeling, South India, Western Himalaya (Dehradun, Delhi), Rajasthan (Gangulee, 1969; Alam et al., 2014a; 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.26; Figs. 73-76)

*Hyophila spathulata* exhibited a substantial activity with a broad ranged ZOI values against all the bacterial strains varies between 5-29 mm but still the antagonistic effect against *B. subtilis* and *E. coli* was not so significant.

**Antifungal Activity** (Photoplate 4.27; Figs. 77-81)

Moderate activity was observed against *A. niger* and *T. viride* with ZOI ranging between 3-19 mm followed by *F. solani* with ZOI values of 2-17 mm.
D. *Hyophila comosa* Dix. et Varde in Arch. Bot., 1: (1927)

(Photoplate 4.28; Figs. A-F)

**Description of plant**- Usually unbranched, simple plants of up to 1 cm height. Leaves are arranged in interrupted rosettes, spreading to erectopatent, curled and inrolled when dry, spatulate from a narrow base, carinate, short base with transparent cells, broad apex, acuminate; flat and entire margin. Strong, short excurrent costa. Upper lamina cells multipapillate, rounded hexagons; basal cells are rectangular, narrow towards margin and shorter rectangular towards top.

**Habitat**- Usually on the moist soil on the bank of river or pond.

**Sexuality**- Monoicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Tonk (Banasthali) (around Department of Bioscience and Biotechnology premises, Banasthali University), alt.- 320 m; dated- Sept. 2014; leg.- A. Bishnoi; det.- A. Alam; Specimen examined: BURI 7860032/14.

**Distribution in the world**- Mexico, Netherlands, Panama, Paraguay, South Africa, Sri Lanka, Tanzania, Peru, Philippines, India (Gangulee, 1969; Choudhary & Deora 2001).

**Distribution in India**- South India, Odisha, Palni, North- East India, Manipur, Rajasthan (Gangulee, 1969; Choudhary & Deora 2001; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.29; Figs. 82-85)

*Hyophila comosa* showed a remarkable activity against all the 3 bacterial strains with elevated range of ZOI values except for *Enterobacter* spp.

**Antifungal Activity** (Photoplate 4.30; Figs. 86-90)

The plant extracts were found least active against all the selected fungal species with ZOI ranges in between 2-12 mm.

Simple (except proliferations), erect to prostrate stem. Dioicous. Dry leaves imbricate to crispate, erectopatent; when moist lingulate-lanceolate, acute to obtuse; margin usually unbroken and flat, may be reflexed and denticulate at apex. Basal leaf cells are lax, rectangular; upper cells quadrate, usually papillose. Capsule erect, cylindrical.

A. Hydrogonium arcuatum (Griff.) Wijk. & Marg. in Taxon, 7: 289 (1958)

(Photoplate 4.31; Figs. A-H)

Description of plant- Somewhat stiff, yellowish-green, tufted plants. Stem is about 2cm long, brown, mainly unbranched, uniformly covered with leaves. Leaves clinging to stem and slightly crispate when dry; carinate-concave, 1mm long and 0.3mm wide at base, lanceolate from a broader base. Margin entire and flat. Pointed, acute leaf tip, may be one or two dentations at the extreme apex. Prominent, yellow-brown, smooth costa, percurrent or ending in a tiny point. All leaf cells are smooth; basal cells are elongated rectangular; upper cells are subquadrate, chlorophyllose, may be papillose.

Habitat- Generally grows on moist soil, old walls, sometimes in association with Gymnostomiella and Riccia sp.

Sexuality- Dioicous (Gangulee, 1969-1980).

Specimen examined- Rajasthan- Mount Abu (Guru Shikhar and around Nakki lake), altitude 1160m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860216/14.

Distribution in the world- Burma, New Guinea, Japan, China, Philippines, Indonesia, India (Gangulee, 1969; Choudhary & Deora 2001).

Distribution in India- Nepal, Lower Bengal, Darjeeling-Sikkim, Arunachal Pradesh, Assam, Odisha, Western Himalaya, Upper Gangetic Plains, Kashmir, South India, Rajasthan (Gangulee, 1969; Choudhary & Deora 2001; Alam, 2015).

Antibacterial Activity (Photoplate 4.32; Figs. 91-94)

With significant ZOI values of 10-26 mm, E. coli and S. aureus were found most prone bacteria against the extracts of Hydrogonium arcuatum.

Antifungal Activity (Photoplate 4.32; Figs. 95-99)

Antifungal activity against A. niger and T. viride was the only noticeable one, but the range of inhibition was narrow, 3-18 mm.
B. *Hydrogonium amplexifolium* (Mitt.) Chen in Hedwigia, 80: 240 (1941)

(Photoplate 4.34; Figs. A-H)

**Description of plant**- Yellow-green plants growing in dense tufts. Usually unbranched stems up to 2.5cm high, covered with leaves which are shorter and sparse at the base. Leaves soft, erectopatent, appressed to stem and crispate when dry, around 2mm long, lanceolate from a wide but lax base. Margins are flat, unbroken, often wavy; sharply pointed tip. Prominent, brown, excursive costa. Lower lamina cells smooth but firm, rectangular; upper cells irregularly rounded hexagons.

**Habitat**- Grows mostly on moist rock or soil or sand covered rocks or old cement walls.

**Sexuality**- Dioicous (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Mount Abu (Guru Shikhar and around Nakki lake), altitude 1160m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860240/14.

**Distribution in the world**- North & South America (Central Mexico), Europe (England, Wales), North to East Africa (Ethiopia, Kenya, Tanzania), China, Iraq, Iran, Russia, India (Gangulee, 1969-1980).

**Distribution in India**- Darjeeling, Kashmir, Western Himalaya, Mussoorie, Manipur, Rajasthan (Gangulee, 1969-1980; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.35; Figs. 100-103)

The observable activity with ZOI between 5-20 mm was reported only against *E.coli* and *B. subtilis*.

**Antifungal Activity** (Photoplate 4.36; Figs. 104-108)

The activity was identifiable only against *F. solani*, with ZOI value between 3-19 mm.

(Photoplate 4.37; Figs. A-H)

**Description of plant**- Dense green tufts, usually unbranched plants. Stems erect, up to 1 cm high, slightly covered with erectopatent, soft leaves. Leaves erect, appressed and incurved when dry; around 2 mm long, lingulate to lanceolate from gradually broader, concave base; narrow, blunt pointed tip; margins are flat and entire. Prominent, brown, rough, percurrent costa. Leaf cells distinct, pellucid; upper cells quadrate to tiny rectangular, papillose; basal cells elongated rectangular, smooth.

**Habitat**- On rocks or soil in moist places.

**Sexuality**- Dioicus (Gangulee, 1969-1980).

**Specimen examined**- Rajasthan- Mount Abu (Guru Shikhar, Sunset point and around Nakki lake), altitude 1160 m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860051/14.

**Distribution in the world**- Vietnam, Indonesia, China, Sumatra, Celebes, Philippines, Sri Lanka, India (Gangulee, 1969-1980).

**Distribution in India**- Upper Assam, North Bengal, Kashmir, Western Himalaya, Punjab, Rajasthan (Gangulee, 1969-1980; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.38; Figs. 109-112)

*Hydrogonium javanicum* exhibited fair activity with ZOI ranging between 5-21 mm against *E. coli* and *S. aureus*.

**Antifungal Activity** (Photoplate 4.39; Figs. 113-117)

*A. niger* and *F. solani* were found fairly susceptible against plant extracts with ZOI between 3-19 mm.
Sub-Family Trichostomoideae (Schimper) Brotherus in H. G. A. Engler and K. Prantl, Nat. Pflanzenfam. 212: 381 (1902)

VII. Timiella (De. Not.) Limpr., Laumb. Deutschl., 1: 590 (1888)

Dull yellow-green to green, dioicous or monoicous growing in loose or dense tufts. Erect, scantily and irregularly branched. Leaves erect; incurved and contorted when dry, spreading when moist; apex acute; margins denticulate or serrate above. Costa percurrent to short excurrent. Upper cells rounded-quadrate, firm-walled, mammillose; basal cells enlarged, thin-walled, smooth.

A. Timiella anomala (Bruch, Schimp. & Gumb.) Limpr. Laubm. Deutschl. 1: 592 (1888)

(Photoplate 4.40; Figs. A-H)

Habit- Green, robust, patchy, branched plants growing in tufts with erect stem of 2.5-3cm height. Leaves are erect, spreading (moist) and curved (dry), small in size, dense at apex, lanceolate-lingulate; acute, toothed apex. Margins entire and wavy. Costa strong, percurrent. Upper lamina cells rounded-quadrate; basal cells quadrate-rectangular, hyaline. Sporophyte erect, apical, long seta with cylindrical, broader and brown capsule with peristome.

Habitat- Usually grows on moist soil in shady places or on old walls or moist rocks.

Sexuality- Dioicous (Choudhary & Deora, 2001).

Specimen examined- Rajasthan- Sawai Madhopur (Ranthambore National Park), alt.- 215-550m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860006/14.

Distribution in the world- United States, Mexico, Canary Islands, India (Choudhary & Deora, 2001).

Distribution in India- Uttar Pradesh, Kumaon, Kangra, Punjab, Chakrata, Rajasthan, Palni Hills (Choudhary & Deora, 2001; Alam et al., 2015).

Antibacterial Activity (Photoplate 4.41; Figs. 118-121)

An amazing activity was exhibited by *Timiella anomala* against all the 4 bacteria. ZOI values also ranging between 3-28 mm. However, comparatively least activity was reported against *E. coli*.

Antifungal Activity (Photoplate 4.42; Figs. 122-126)

The observable activity was only reported against *T. viride* with ZOI range of 2-19 mm.
**Sub-Family Pottioidae** Brotherus in H. G. A. Engler et al., Nat. Pflanzenfam. ed. 2. 10: 282 (1924)

**VIII. Gymnostomiella** Fleisch. Musci Buitenzorg, 1: 309 (1904)

Very small, delicate, dioicous plants grow in tufts or mats. Stems simple or forked, leaves oblong-obovate to elliptic, spreading or erect at base, erect when dry, erect-spreading when moist; apices broadly rounded to obtuse; margins plane. Costa slender, percurrent or ending below the apex. Upper cells irregularly hexagonal, subquadrate to short-rectangular, thin-walled; basal cells long-rectangular, smooth.

**A. Gymnostomiella vernicosa** (Hook. ex Harv.) M. Fleisch. Musci Buitenzorg 1: 310 (1904)

(Photoplate 4.43; Figs. A-F)

**Description of plant**—Very small, delicate, dioicous, light-green plants growing in mats or tufts. Stem forked or simple, reddish-brown, about 0.8cm in height. Leaves upto 0.2mm long, narrower base than apex, spatulate, oblong, erect to spreading (moist), somewhat erect and inrolled (dry), broadly rounded apex; plain, flat margins. Percurrent, slender costa. Upper lamina cells irregularly hexagonal to short-rectangular, papillose; basal cells are smooth, long-rectangular and are shorter towards margin.

**Habitat**—Generally grows on rocks, clay soil, limestones.

**Sexuality**—Dioicous (Choudhary & Deora, 2001).

**Specimen examined**—Rajasthan- Sawai Madhopur (Ranthambore National Park), alt.- 215-550m; dated- Aug. 2014; leg.- Alam et al.; det.- A. Alam; Specimen examined: BURI 7860237/14.

**Distribution in the world**—South-eastern U.S.A.; Mexico; Central America; Caribbean, Western South America, Brazil; Indo-China, Malaysia; Australia, India (Choudhary & Deora, 2001).

**Distribution in India**—Western Himalayas, Delhi, Uttar Pradesh, Bombay, South India, Punjab, Rajasthan (Choudhary & Deora, 2001; Alam et al., 2014a; 2014b; Alam, 2015).

**Antibacterial Activity** (Photoplate 4.44; Figs. 127-130)

The noticeable activity was recorded against the 3 bacteria, except $S. aureus$, where the ZOI values range from 3-25 mm.

**Antifungal Activity** (Photoplate 4.45; Figs. 131-135)

Only $F. solani$ was found susceptible against *Gymnostomiella vernicosa* extract with ZOI values ranging between 4-29 mm.
Photoplate 4.1: Figs. A-J: *Anoectangium clarum* Mitt.: (A) Plant, (B) Portion of plant (x4), (C) T.S. of portion of stem (x45), (D) Complete leaf (x4), (E) Leaf apex (x10), (F) Leaf median (x10), (G) Leaf base (x10), (H) Apical cells of leaf (x45), (I) Median cells of leaf (x45), (J) Basal cells of leaf (x45). All pictures are taken from BURI7860239/13.
Photoplate 4.2: Figs. 1-4: Antibacterial activity of various extracts of *Anoectangium clarum* Mitt. at different concentration (1%-5%) of solvents. [Fig. 1: against *B. subtilis*; Fig. 2: against *Enterobacter* spp.; Fig. 3: against *E. coli*; Fig. 4: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.3: Figs. 5-9: Antifungal activity of various extracts of *Anoectangium clarum* Mitt. at different concentration (1% - 5%) of solvents. [Fig. 5: against *A. niger*; Fig. 6: against *B. cinerea*; Fig. 7: against *F. solani*; Fig. 8: against *M. phaseolina*; Fig. 9: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.4: Figs. A-F: *Anoectangium stracheyanum* Mitt.: (A) Plant, (B) T.S. of portion of plant stem (x45), (C) Plant leaf (x10), (D) Leaf apex (x45), (E) Leaf median (x45), (F) Leaf base (x45). All pictures are taken from BUR17860232/13.
Antibacterial activity of various extracts of *Anoectangium stracheyanum* Mitt at different concentration (1% -5%) of solvents. [Fig. 10: against *B. subtilis*; Fig. 11: against *Enterobacter* spp.; Fig. 12: against *E. coli*; Fig. 13: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.6: Figs. 14-18: Antifungal activity of various extracts of *Anoectangium stracheyanum* Mitt at different concentration (1% -5%) of solvents. [Fig. 14: against *A. niger*; Fig. 15: against *B. cinerea*; Fig. 16: against *F. solani*; Fig. 17: against *M. phaseolina*; Fig. 18: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.7: Figs. A-H: *Molendoa roylei* (Mitt.) Broth.: (A) Plant, (B) Portion of plant (x4), (C) Plant sporophyte (x4), (D) T.S. of portion of stem (x45), (E) Leaf (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860219BURI/13.
**Photo Plate 4.8:** Figs. 19-22: Antibacterial activity of various extracts of *Molendoa roylei* (Mitt.) Broth. at different concentration (1% -5%) of solvents. [Fig. 19: against *B. subtilis*; Fig. 20: against *Enterobacter* spp.; Fig. 21: against *E. coli*; Fig. 22: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.9: Figs. 23-27: Antifungal activity of various extracts of *Molendoa roylei* (Mitt.) Broth. at different concentration (1% -5%) of solvents. [Fig. 23: against *A. niger*; Fig. 24: against *B. cinerea*; Fig. 25: against *F. solani*; Fig. 26: against *M. phaseolina*; Fig. 27: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.10: Figs. A-H: *Molendoa sendtneriana* (Bruch, Schimp. & Gumb.) Limpr.: (A) Plant, (B) Portion of plant (x4), (C) T.S. of portion of stem (x45), (D) Leaf (x10), (E) Leaf apex (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860209BURI/13.
Photoplate 4.1: Figs. 28-31: Antibacterial activity of various extracts of *Molendoa sendtneriana* (Bruch, Schimp. & Gumb.) Limpr. at different concentration (1% - 5%) of solvents. [Fig. 28: against *B. subtilis*; Fig. 29: against *Enterobacter* spp.; Fig. 30: against *E. coli*; Fig. 31: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.12: Figs. 32-36: Antifungal activity of various extracts of *Molendoa sendtneriana* (Bruch, Schimp. & Gumb.) Limpr. at different concentration (1% - 5%) of solvents. [Fig. 32: against *A. niger*; Fig. 33: against *B. cinerea*; Fig. 34: against *F. solani*; Fig. 35: against *M. phaseolina*; Fig. 36: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.13: Figs. A-H: *Gymnostomum calcareum* Nees & Hornsch.: (A) Plant, (B) Plant portion (x10), (C) T.S. of portion of plant stem (x45), (D) Leaf (x10), (E) Leaf apex (x45), (F) Leaf median (x10), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from BURI7860105/14.
Photoplate 4.1: Figs. 37-40: Antibacterial activity of various extracts of Gymnostomum calcarenum Nees & Hornsch. at different concentration (1% -5%) of solvents. [Fig. 37: against B. subtilis; Fig. 38: against Enterobacter spp.; Fig. 39: against E. coli; Fig. 40: against S. aureus]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.15: Figs. 41-45: Antifungal activity of various extracts of Gymnostomum calcareum Nees & Hornsch. at different concentration (1%-5%) of solvents. [Fig. 41: against A. niger; Fig. 42: against B. cinerea; Fig. 43: against F. solani; Fig. 44: against M. phaseolina; Fig. 45: T. viride]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.16; Figs. A-H: *Hymenostylium recurvostrae* (Hedw.) Dix.: (A) Plant, (B) Plant portion (x10), (C) T.S. of portion of plant stem (x45), (D) Leaf (x4), (E) Leaf (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860238BURI14.
Photoplate 4.17: Figs. 46-49: Antibacterial activity of various extracts of *Hymenostylium recurvirostre* (Hedw.) Dix. at different concentration (1% -5%) of solvents. [Fig. 46: against *B. subtilis*; Fig. 47: against *Enterobacter* spp.; Fig. 48: against *E. coli*; Fig. 49: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.18: Figs. 50-54: Antifungal activity of various extracts of *Hymenostylium recurvirostre* (Hedw.) Dix. at different concentration (1% -5%) of solvents. [Fig. 50: against *A. niger*; Fig. 51: against *B. cinerea*; Fig. 52: against *F. solani*; Fig. 53: against *M. phaseolina*; Fig. 54: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.19; Figs. A-H: *Hyophila involuta* (Hook.) Jaeg.: (A) Plant, (B) Portion of plant (x4), (C) Leaf (x10), (D) Leaf apex (x45), (E) Leaf median (x45), (F) Leaf base (x45), (G) Median cells of leaf (x45), (H) T.S. of portion of stem (x45). All pictures are taken from 7860209BURI/14.
Photoplate 4.20: Figs. 55-58: Antibacterial activity of various extracts of *Hyophila involuta* (Hook.) Jaeg. at different concentration (1% -5%) of solvents. [Fig. 55: against *B. subtilis*; Fig. 56: against *Enterobacter* spp.; Fig. 57: against *E. coli*; Fig. 58: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.21: Figs. 59-63: Antifungal activity of various extracts of *Hyophila involuta* (Hook.) Jaeg. at different concentration (1% - 5%) of solvents. [Fig. 59: against *A. niger*; Fig. 60: against *B. cinerea*; Fig. 61: against *F. solani*; Fig. 62: against *M. phaseolina*; Fig. 63: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.22: Figs. A-H: *Hyophila rosea* Williams: (A) Plant, (B) Plant sporophyte (x4), (C) T.S. of portion of stem (x45) (D) Leaf (x10), (E) Leaf apex (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860225BURI/14.
Photoplate 4.23: Figs. 64-67: Antibacterial activity of various extracts of *Hyophila rosea* Williams at different concentration (1%-5%) of solvents. [Fig. 64: against *B. subtilis*; Fig. 65: against *Enterobacter* spp.; Fig. 66: against *E. coli*; Fig. 67: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.24: Figs. 68-72: Antifungal activity of various extracts of *Hyophila rosea* Williams at different concentration (1% -5%) of solvents. [Fig. 68: against *A. niger*; Fig. 69: against *B. cinerea*; Fig. 70: against *F. solani*; Fig. 71: against *M. phaseolina*; Fig. 72: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.25: Figs. A-J: *Hyophila spathulata* (Harv.) Jaeg.: (A) Plant, (B) Portion of plant (x4), (C) T.S. of portion of plant stem (x45), (D) Complete leaf (x4), (E) Leaf Apex (x10), (F) Apex cells of leaf (x45), (G) Leaf Median (x10), (H) Median cells of leaf (x45), (I) Leaf Base (x10), (J) Basal cells of leaf (x45). All pictures are taken from 7860202BURI14.
Photoplate 4.26: Figs. 73–76: Antibacterial activity of various extracts of *Hyophila spathulata* (Harv.) Jaeg. at different concentration (1%-5%) of solvents. [Fig. 73: against *B. subtilis*; Fig. 74: against *Enterobacter* spp.; Fig. 75: against *E. coli*; Fig. 76: against *S. aureus*]  

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.27: Figs. 77-81: Antifungal activity of various extracts of *Hyophila spathulata* (Harv.) Jaeg. at different concentration (1% -5%) of solvents. [Fig. 77: against *A. niger*; Fig. 78: against *B. cinerea*; Fig. 79: against *F. solani*; Fig. 80: against *M. phaseolina*; Fig. 81: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.28: Figs. A-H: *Hyophila comosa* Dix.: (A) Plant, (B) Plant portion (x10), (C) Leaf (x10), (D) Apex cells of leaf (x45), (E) Median cells of leaf (x45), (F) Basal cells of leaf (x45). All pictures are taken from 7860032BUR/14.
Photoplate 4.29 Figs. 82-85: Antibacterial activity of various extracts of *Hyophila comosa* Dix. at different concentration (1% - 5%) of solvents. [Fig. 82: against *B. subtilis*; Fig. 83: against *Enterobacter* spp.; Fig. 84: against *E. coli*; Fig. 85: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.30: Figs. 86-90: Antifungal activity of various extracts of *Hyophila comosa* Dix. at different concentration (1% -5%) of solvents. [Fig. 86: against *A. niger*; Fig. 87: against *B. cinerea*; Fig. 88: against *F. solani*; Fig. 89: against *M. phaseolina*; Fig. 90: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photo plate 4.31: Figs. A-H: *Hydrogonium arcuatum* (Griff.) Wijk. & Marg.: (A) Plant, (B) Portion of plant (x4), (C) T.S. of portion of stem (x45), (D) Leaf (x4), (E) Leaf (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860216BURI14.
Photoplate 4.32: Figs. 91-94: Antibacterial activity of various extracts of *Hydrogonium arcuatum* (Griff.) Wijk. & Marg. at different concentration (1%-5%) of solvents. [Fig. 91: against *B. subtilis*; Fig. 92: against *Enterobacter* spp.; Fig. 93: against *E. coli*; Fig. 94: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Fig. 95: Photoplate 4.33: Figs. 95-99: Antifungal activity of various extracts of *Hydrogonium arcuatum* (Griff.) Wijk. & Marg. at different concentration (1% -5%) of solvents. [Fig. 95: against *A. niger*; Fig. 96: against *B. cinerea*; Fig. 97: against *F. solani*; Fig. 98: against *M. phaseolina*; Fig. 99: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photo plate 4.34; Figs. A-H: *Hydrogonium amplexifolium* (Mitt.) Chen: (A) Plant, (B) Plant portion (x10), (C) T.S. of portion of plant stem (x45), (D) Leaf apex (x10), (E) Leaf median (x10), (F) Median cells of leaf (x45), (G) Leaf basal (x10), (H) Basal cells of leaf (x45). All pictures are taken from 7860240BURI/14.
Photoplate 4.35: Figs. 100-103: Antibacterial activity of various extracts of *Hydrogonium amplexifolium* (Mitt.) Chen at different concentration (1% - 5%) of solvents. [Fig. 100: against *B. subtilis*; Fig. 101: against *Enterobacter* spp.; Fig. 102: against *E. coli*; Fig. 103: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.36: Figs. 104-108: Antifungal activity of various extracts of *Hydrogonium amplexifolium* (Mitt.) Chen at different concentration (1% -5%) of solvents. [Fig. 104: against *A. niger*; Fig. 105: against *B. cinerea*; Fig. 106: against *F. solani*; Fig. 107: against *M. phaseolina*; Fig. 108: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
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Photoplate 4.37; Figs. A-H: *Hydrogonium javanicum* (Doz. & Molk.) Hilp.: (A) Plant, (B) Plant portion (x10), (C) T.S. of portion of plant stem (x45), (D) Leaf (x10), (E) Leaf apex (x45), (F) Leaf median (x10), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860051BURI/14.
Photoplate 4.38: Figs. 109-112: Antibacterial activity of various extracts of *Hydrogonium javanicum* (Doz. & Molk.) Hilp. at different concentration (1% -5%) of solvents. [Fig. 109: against *B. subtilis*; Fig. 110: against *Enterobacter* spp.; Fig. 111: against *E. coli*; Fig. 112: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.39: Figs. 113-117: Antifungal activity of various extracts of Hydrogonium javanicum (Doz. & Molk.) Hilp. at different concentration (1%-5%) of solvents. [Fig. 113: against A. niger; Fig. 114: against B. cinerea; Fig. 115: against F. solani; Fig. 116: against M. phaseolina; Fig. 117: T. viride]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photo plate 4.40; Figs. A-H: *Timiella anomala* (Bruch, Schimp. & Gumb.) Limpr.: (A) Plant, (B) Plant sporophyte (x4), (C) T.S. of portion of stem (x45), (D) Leaf (x4), (E) Leaf apex (x10), (F) Apex cells of leaf (x45), (G) Median cells of leaf (x45), (H) Basal cells of leaf (x45). All pictures are taken from 7860006BURI/14.
Photoplate 4.41: Figs. 118-121: Antibacterial activity of various extracts of _Timiella anomala_ (Bruch, Schimp. & Gumb.) Limpr. at different concentration (1%-5%) of solvents. [Fig. 118: against _B. subtilis_; Fig. 119: against _Enterobacter_ spp.; Fig. 120: against _E. coli_; Fig. 121: against _S. aureus_]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.- Antibacterial discs in various solvents]
Photoplate 4.42: Figs. 122-126: Antifungal activity of various extracts of *Timiella anomala* (Bruch, Schimp. & Gumb.) Limpr. at different concentration (1% -5%) of solvents. [Fig. 122: against *A. niger*; Fig. 123: against *B. cinerea*; Fig. 124: against *F. solani*; Fig. 125: against *M. phaseolina*; Fig. 126: *T. viride*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]
Photoplate 4.43; Figs. A-F: Gymnostomiella vernicosa (Hook. ex Harv.) M. Fleisch.: (A) Plant, (B) Plant (x4), (C) Plant leaf (x10), (D) Leaf apex (x45), (E) Leaf median (x45), (F) Leaf base (x45). All pictures are taken from 7860237BURI14.
Antibacterial activity of various extracts of *Gymnostomiella vernicosa* (Hook. ex Harv.) M. Fleisch. at different concentration (1% - 5%) of solvents. [Fig. 127: against *B. subtilis*; Fig. 128: against *Enterobacter* spp.; Fig. 129: against *E. coli*; Fig. 130: against *S. aureus*]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Ab.-Antibacterial discs in various solvents]
Photoplate 4.45: Figs. 131-135: Antifungal activity of various extracts of Gymnostomiella vernicosa (Hook, ex Harv.) M. Fleisch. at different concentration (1% -5%) of solvents. [Fig. 131: against A. niger; Fig. 132: against B. cinerea; Fig. 133: against F. solani; Fig. 134: against M. phaseolina; Fig. 135: T. viride]

[AC- acetone; CF- chloroform; DW- distilled water (aqueous extract); ET- ethanol; MT- methanol] [Af.- Antifungal discs in various solvents]