



Research article

Bryophyte diversity in Terai regions of Uttar Pradesh, India with some new additions to the state

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Abstract: An investigation of the Bryophytes from Terai region of Uttar Pradesh has revealed the occurrence of 29 species of bryophytes: 21 species belonging to 16 genera of 11 Families of Mosses; 6 species belonging to 3 genera of 3 families of Liverworts and 2 species belonging to 1 genus of 1 family of Hornworts. This includes several new reports viz., *Notothylas kashyapii* D.K. Singh from Gangetic Plains, *Dicranella macrospora* Gangulee, *Entodontopsis tavoyense* (Hook. ex Harv.) W.R. Buck & R.R. Ireland, *Trachyphyllum inflexum* (Harv.) Gepp., *Weissia controversa* Hedw., *Fissidens crenulatus* Mitt., *Fissidens flaccidus* Mitt. and *Fissidens zollingeri* Mont. from Uttar Pradesh.

Keywords: Uttar Pradesh - Terai region - Liverworts - Hornworts - New record.

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INTRODUCTION

Uttar Pradesh (U.P.) can be divided into three topographical zones (i) The sub Himalayan Terai region in the North (ii) The Gangetic Plain in the centre (iii) The Vindhya Hills and plateau in the South. In the state average temperature ranges from 0° to 46 °C and average annual rainfall is around 65 to 70 cm (https://en.wikipedia.org/wiki/Climate_of_Uttar_Pradesh). A total of 9.26% of the state's geographic area is under forest/tree cover in U.P. Thus area is not much favourable for the growth of bryophytes. Various workers from time to time made an attempt to provide consolidated account of bryophytes of Uttar Pradesh (Ahmad 1942, Pande & Ahmad 1944, Pande *et al.* 1954, Sahai 1962, Sahai & Sinha 1972, Srivastava 1964, Sinha *et al.* 1990, Singh & Kumar 2003, Singh *et al.* 2005, Lal 2007, Nath *et al.* 2010, Kumar & Kazmi 2004, 2006). Singh (2013) has listed 27 species of liverworts, 3 species of hornworts and 24 species of mosses from Uttar Pradesh. During the course of bryological exploration in that region, the authors come across some interesting taxa of bryophytes. In the present study, an attempt has been made to provide an enumeration of bryophytes of this area with ecology and distribution, range in India and abroad along with details of specimens examined.

MATERIALS AND METHODS

Plant exploration trip has been undertaken to Lakhimpur, Pilibhit and their neighbouring areas in Uttar Pradesh. Bryophyte plant samples has been collected from Gola forest, Salempur Forest Division, Malani Range, Lalapur, near forest nursery, Lakhimpur-Kheri and Pilibhit Tiger Reserve, Barahi range. Collected specimens have been deposited in Herbarium, CSIR-National Botanical Research Institute, Lucknow (LWG).

RESULTS AND DISCUSSION

During the present investigation on the bryophytes of Pilibhit Tiger Reserve and its neighbouring areas (Lakhimpur-Kheri, Gola, Shahjahanpur) about 30 taxa has been identified and enumerated. It includes an account of 22 species belonging to 17 genera of 11 Families of Mosses, 6 species belonging to 3 genera of 3 families of Liverworts and 2 species belonging to 1 genus of 1 family of Hornworts. During the study one Hornwort, *Notothylas kashyapii* D.K. Singh from Gangetic plains; and 8 mosses, *Dicranella macrospora* Gangulee, *Entodontopsis tavoyense* (Hook. ex Harv.) W.R. Buck & R.R. Ireland, *Trachyphyllum inflexum* (Harv.) Gepp., *Weissia controversa* Hedw., *Fissidens crenulatus* Mitt., *Fissidens flaccidus* Mitt. and *Fissidens zollingeri* Mont. are reported from Uttar Pradesh for the first time.

It has been observed that terricolous forms are dominant than epiphytic ones and out of 30 taxa investigated from the area, mosses viz., *Barbula indica*, *Philonotis mollis*, *Fissidens zollingeri* and *Hyophila nymaniana* were more frequent in occurrence. Among liverworts *Riccia billardieri* and *Cyathodium cavernarum* have been frequently found in the area. Among the mosses, family Pottiaceae seems to be more dominant in the region with 5 taxa and Genus *Fissidens* has maximum number (5) of species. As far as the liverworts are concerned, family Ricciaceae exhibits maximum number of 4 species.

Enumeration

Liverworts

Family - Aytoniaceae

1. *Plagiochasma appendiculatum* Lehm. et Lindenb; Pag. IV. 14 (1832). (Fig. 1A)

Habitat: On stony wall, soil; Altitude- 452–536 ft.

Distribution: Central India (Amarkantak, Pachmarhi), Eastern Himalaya (Assam, Darjeeling, Sikkim), Gangetic Plains (Uttar Pradesh), Punjab and West Rajasthan plain, South India (Maharashtra, Munnar, Tamil Nadu), Western Himalaya (Corbett National Park, Dhanolti, Himachal Pradesh- GHNP, Kangra, Kullu, Simla, Nainital, Mussoorie, Ranikhet); Afghanistan, Africa, China, Myanmar, Nepal, Pakistan, Philippines, Vietnam.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Near Radha Swami Inter College, Kevalpurva, N 27°53.194' E 80°56.046', 08.09.2014, *Vinay Sahu* 257465A (LWG); Pilibhit Dist., Chimitiya Puranpur, Barahi range, N 28°37.006' E 80°11.5', 11.09.2014, *Vinay Sahu* 258207A (LWG).

Family - Cyathodiaceae

2. *Cyathodium cavernarum* Kunze in Lehm., Pugillus 6: 17 (1834) Mont. in Ramon de la Sagra, Hist. de Cuba; Crypt. 491, tab. 19, Syn. Hepat. 577 (1846). (Fig. 1B)

Habitat: On stony wall, soil; Altitude- 452–600 ft.

Distribution: Central India (Gujarat, Madhya Pradesh), Eastern Himalaya (Darjeeling, Khasi Jaintia Hills, Shillong), Gangetic Plains (Uttar Pradesh – Bareilly, Lucknow), South India (Mumbai, Elephanta caves, Khandala, Mahabaleshwar, Malabar Hills, Panchagani, Pratabgarh), Western Himalaya (Dehradun, Gunkhal, Karn Prayag, Mussoorie, Salkuli); Africa, America, Myanmar, Java.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Near Radha Swami Inter College, Kevalpurva, N 27°53.194' E 80°56.046', 08.09.2014, *Vinay Sahu* 257464A, 257465D (LWG); Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257470A (LWG); Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257481A (LWG); Pilibhit Dist., Near Forest Office, Mala range, Rechaula, N 28°37.070' E 79°54.894', 11.09.2014, *Vinay Sahu* 257495A (LWG); Barahi Range 72, N 28°37.006' E 80°11.5', 11.09.2014, *Vinay Sahu* 258204 A (LWG); Chimitiya Puranpur, Barahi range, N 28°37.006' E 80°11.5', 11.09.2014, *Vinay Sahu* 258213A (LWG).

Family - Ricciaceae

3. *Riccia billardieri* Mont. et Nees in Gottsche, Lindenberg & Nees, Syn. Hepat. 4: 602. (Fig. 1C)

Habitat: On soil; Altitude- 485–547ft.

Distribution: Central India (Gujarat, Jharkhand, Madhya Pradesh, Rajasthan), Eastern Himalaya (Assam, Manipur, Sikkim), Gangetic Plains (Uttar Pradesh, West Bengal), South India (Andaman, Karnataka, Kerala, Maharashtra, Tamil Nadu), Western Himalaya (Himachal Pradesh, Uttarakhand); Australia, Bangladesh, Indonesia, Nepal, Philippines, Sri Lanka, Thailand.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257467B, 257468B, 257471A (LWG); Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257476A, 257477E (LWG); Pilibhit Dist., Barahi Range 72, N 28°37.006' E 80°11.5', 11.09.2014, *Vinay Sahu* 258203A, 258210A (LWG).

4. *Riccia gangetica* Ahmad Ahmad ex L.Söderstr., A. Hagborg et von Konrat, Phytotaxa 65: 57 (2012). (Fig. 1D)

Habitat: On soil; Altitude- 530–600 ft.

Distribution: Central India (Gujarat, Madhya Pradesh Rajasthan), Eastern Himalaya (Meghalaya), Gangetic Plains (Uttar Pradesh, West Bengal), Western Himalaya (Himachal Pradesh, Uttarakhand), South India (Kerala, Maharashtra, Tamil Nadu); Australia, Bangladesh, Indonesia.

Specimens examined: INDIA, Uttar Pradesh, Pilibhit Dist., Pipariya, N 28°32.471' E 79°54.905', 10.09.2014, Vinay Sahu 257493A (LWG); Barahi Range 69, N 28°38.207' E 80°10.465', 11.09.2014, Vinay Sahu 258201A (LWG).

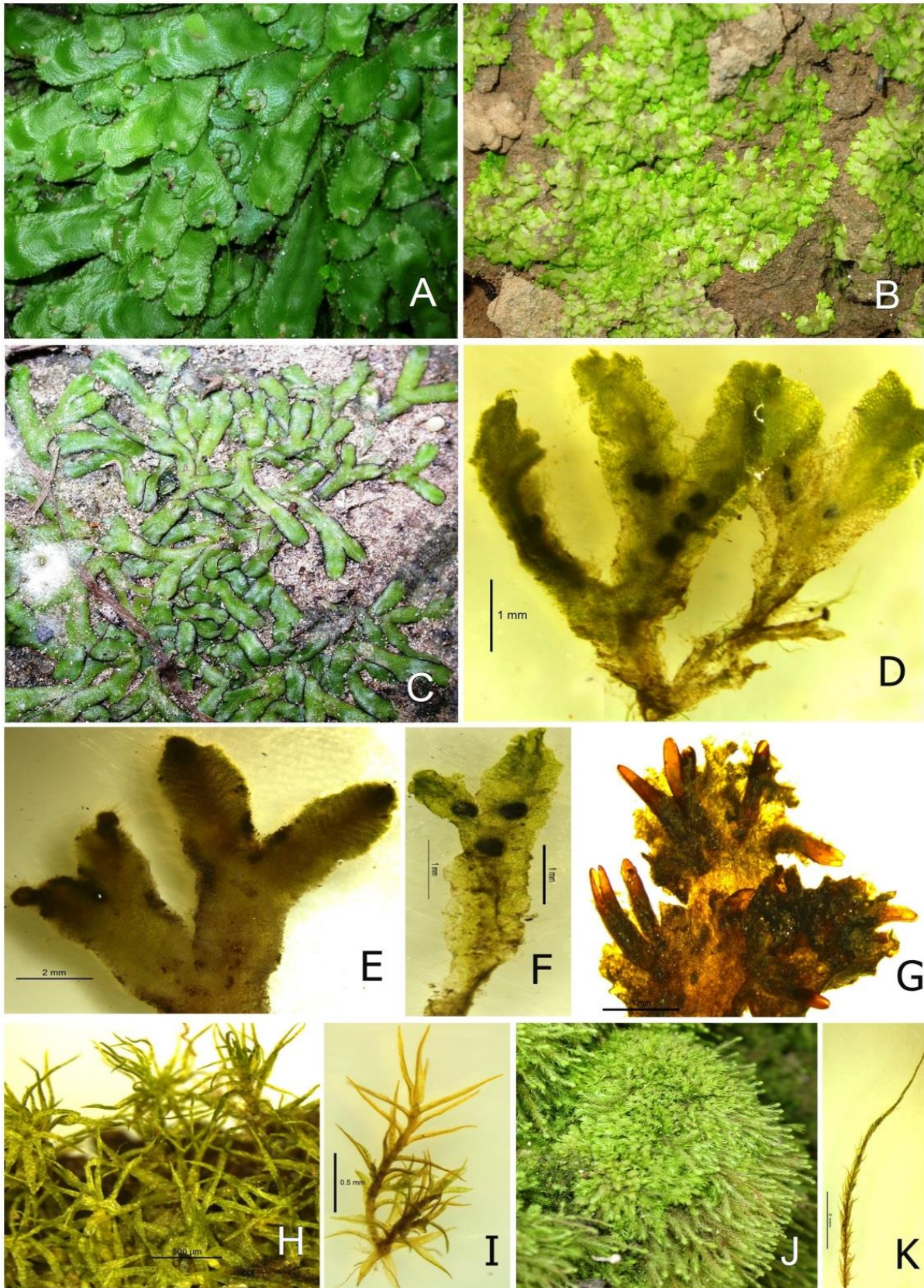


Figure 1. A, *Plagiochasma appendiculatum*; B, *Cyathodium cavernarum*; C, *Riccia billardieri*; D, *Riccia gangetica*; E, *Riccia discolor*; F, *Riccia stricta*; G, *Notothylas indica*; H–I, *Archidium birmannicum*; J–K, *Philonotis mollis*.

5. *Riccia discolor* Lehm. et Lindenberg. in Lehmann, Nov. Stirp. Pug. 4: 1. (1832). (**Fig. 1E**)

R. himalayensis Kashyap, J. Bombay Nat. Hist. Soc. 24: 349. (1916).

Habitat: On soil; Altitude- 600 ft.

Distribution: Central India (Chattishgarh, Gujarat, Madhya Pradesh, Punjab, Rajasthan) Eastern Himalaya (Assam, Sikkim, Meghalaya), Gangetic Plains (Uttarakhand, Uttar Pradesh, West Bengal), Western Himalaya (Himachal Pradesh, Jammu & Kashmir), South India (Karnataka, Kerala, Maharashtra, Tamil Nadu); Africa, Australia, Bangladesh, Myanmar, Nepal, Pakistan, Sri Lanka.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Barahai range 69, N 28°38.207' E 80°10.465', 11.09.2014, *Vinay Sahu* 257497A, 257500A (LWG).

6. *Riccia stricta* (Gottsche, Lindenb. & Nees) Perold, Bothalia 20: 197 (1990). (**Fig. 1F**)

Habitat: On soil; Altitude- 480 ft.

Distribution: Central India (Madhya Pradesh), Eastern Himalaya (Sikkim), South India (Kerala, Tamil Nadu), Gangetic Plains (West Bengal); Africa.

Specimens examined: INDIA, Uttar Pradesh, Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258220E (LWG).

Family - Archidiaceae**7. *Archidium birmanicum*** Mitt. ex Dix. in J. Ind. Bot., 2: 175 (1921). (**Fig. 1H, I**)

Habitat: On stony wall, soil; Altitude- 485–600 ft.

Distribution: Eastern Himalaya (Assam), Gangetic Plains (West Bengal Plains-Ramnagar, Hooghly), South India (Nilgiri and Palni Hills); Myanmar, Nepal.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257467A, 257469A (LWG); Pilibhit Dist., Barahi Range 69, N 28°38.207' E 80°10.465', 11.09.2014, *Vinay Sahu* 257498A, 257500B, 258201B (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258220C (LWG).

Family - Bartramiaceae**8. *Philonotis mollis*** (Dozy & Molk.) Mitt. in Musci Ind. Or.: 60 (1859). (**Fig. 1J, K**)

Habitat: On soil; Altitude- 497–600 ft.

Distribution: Eastern Himalaya (Sikkim), South India (Coorg, Kanara, Andaman Is.), Bhutan, Borneo, Celebes, Japan, Java, Madagascar, Philippines, Sri Lanka, Sumatra, Taiwan, Tonkin.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257480A (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257485A, 257491A (LWG); Pilibhit Dist., Barahi Range 69, N 28°38.207' E 80°10.465', 11.09.2014, *Vinay Sahu* 257499A (LWG); Chintiya, Puranpur, Barahi range, N 28°37.006' E 80°11.5', 11.09.2014, *Vinay Sahu* 258208A, 258210B, 258211B, 258212A, 258214B (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258219A (LWG).

Family - Dicranaceae**9. *Dicranella macrospora*** Gangulee in Nov. Hedwigia, 8: 145 (1964). (**Fig. 2A**)

Habitat: On soil; Altitude- 497 ft.

Distribution: Assam, Uttar Pradesh (Lakhimpur Kheri).

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257484A (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257491B (LWG). **New record to Uttar Pradesh.**

Family - Ditricaceae**10. *Ceratodon purpureus*** (Hedw.) Brid. in Bryol. Univ., 1: 480 (1826). (**Fig. 2D**)

Habitat: On soil; Altitude- 547 ft.

Distribution: Eastern Himalaya (Assam, Darjeeling), Gangetic plains (Raebareli), South India, Western Himalaya (Kashmir); Antarctica, Australia, Brazil, China, Chili, East Nepal, Europe, Japan, Java, Madagascar, New Zealand, North America (including Green Land, Alaska) North, Central and South Africa, Oceania, Siberia, Sri Lanka, Tajikistan, Thailand.

Specimens examined: INDIA, Uttar Pradesh, Pilibhit Dist., Barahi Range 72, N 28°37.006' E 080°11.5', 11.09.2014, Vinay Sahu 258202A (LWG).

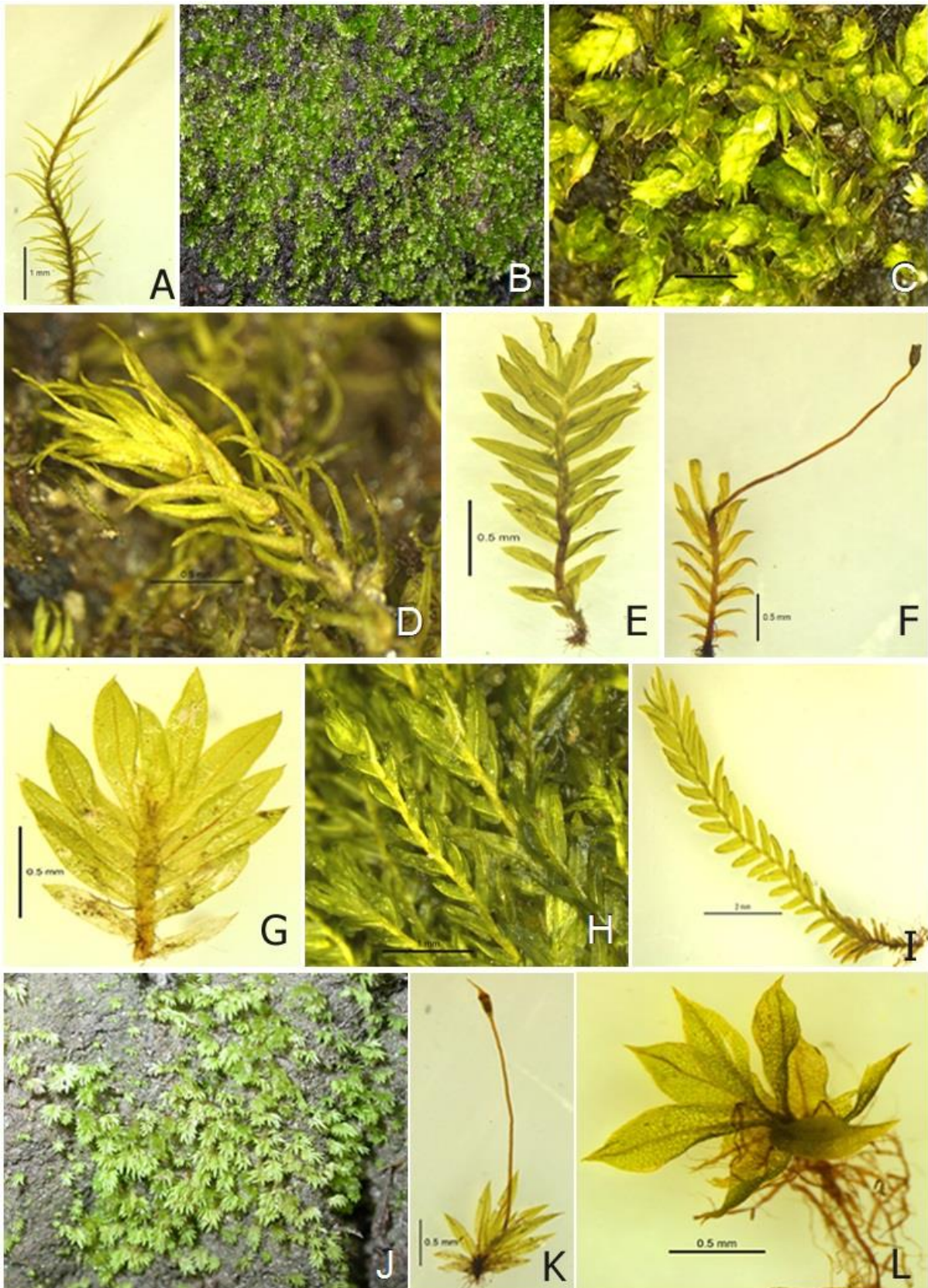


Figure 2. A, *Dicranella macrospora*; B–C, *Erpodium mangiferae*; D, *Ceratodon purpureus*; E, *Fissidens bryoides*; F, *Fissidens crenulatus*; G, *Fissidens flaccidus*; H–I, *Fissidens involutus*; J–K, *Fissidens zollingeri*; L, *Physcomitrium eurystomum*.

Family - Erpodiaceae**11. *Erpodium mangiferae*** C. Muell in *Linnaea* 37: 178. (1873). (**Fig. 2B, C**)*Habitat*: Epiphytic; Altitude- 452 ft.*Distribution*: Central India (Gujarat), Eastern Himalaya (Assam), Gangetic plains (U.P.-Allahabad, Saharanpur; W. Bengal-Kolkata, Hooghly), Western Himalaya (Uttarakhand), South India (W. Ghats of Karnataka, Maharashtra and Tamil Nadu); Bangladesh, Nepal.*Specimens examined*: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Sankarpur police station, N 27°54.352' E 80°54.259', 08.09.2014, *Vinay Sahu* 257466A (LWG); Bira Salempur Forest Division, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257473A (LWG).**Family - Fissidentaceae****12. *Fissidens bryoides*** Hedw. in *Sp. Musc.*: 153 (1801). (**Fig. 2E**)*Habitat*: On soil; Altitude- 536 ft.*Distribution*: Eastern Himalaya (Khasi Hills), Gangetic Plains (Lower Bengal); South India (Coonor, Nilgiri Hills, Western Ghats), Western Himalaya (Nainital, Ranikhet, Simla), Africa, Caucasus, China, East Nepal, Europe, Japan, Java and Philippines, Malay, N. & S. America, Sri Lanka, Siberia, Taiwan.*Specimens examined*: INDIA, Uttar Pradesh, Pilibhit Dist., Chimitiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258214A (LWG).**13. *Fissidens crenulatus*** Mitt. in *Musc. Ind. Or.*: 140 (1859). (**Fig. 2F**)*Habitat*: On soil; Altitude- 418–568 ft.*Distribution*: Gangetic Plains (Orissa), South India; East Nepal, Upper Burma.*Specimens examined*: INDIA, Uttar Pradesh, Pilibhit Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257474B, 257482A, 257483A, 257484B (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257490A, 257491C (LWG); Pilibhit Dist., Near Gajraula, N 28°31.307' E 79°56.937', 12.09.2014, *Vinay Sahu* 258215A (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258219B (LWG). **New record to Uttar Pradesh.****14. *Fissidens flaccidus*** Mitt. in *Transactions of the Linnean Society of London* 23: 56. 6 f. 18 (1860). (**Fig. 2G**)*Fissidens splachnobryoides* Broth. in Schum. *et* Lauterb in *Fl. Deutsch Schutzgeb. Südsee* 81 (1900).*Habitat*: On soil; Altitude- 418–568 ft.*Distribution*: Central India (Pachmarhi), Gangetic Plains (Lower Bengal), South India (Bombay, Khandala), Western Himalaya (Kalka); Africa, Brazil, Borneo, Burma, China, Japan, Java, Nepal, New Guinea, Philippines, Sri Lanka, Vietnam.*Specimens examined*: INDIA, Uttar Pradesh, Lakhimpur Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257478A, 257480B (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257488B (LWG); Pilibhit Dist., Barahi Range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258204C (LWG); Chimitiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258213C (LWG). **New record to Uttar Pradesh.****15. *Fissidens involutus*** Wilson *ex* Mitt. in *J. Proc. Linn. Soc. Botany, Supplement* 2: 138. 1859. (**Fig. 2H, I**)*Habitat*: On soil; Altitude- 536 ft.*Distribution*: Central India (Bastar, Chhotanagpur), Eastern Himalaya (Darjeeling, Sikkim), Gangetic Plains (Saharanpur), South India (Bombay, Khandala), Western Himalaya; Borneo, Burma, China, Nepal, Thailand, Vietnam.*Specimens examined*: INDIA, Uttar Pradesh, Pilibhit Dist., Chimitiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258209A (LWG).**16. *Fissidens zollingeri*** Mont. in *Ann. Sci. Nat. ser.3*, 4: 114 (1845). (**Fig. 2J, K**)*Fissidens xiphioides* Fleisch. in *Hedwigia* 38: 125 (1899).*Habitat*: On soil; Altitude- 418 ft.*Distribution*: Central India (Pachmarhi), Gangetic Plains (Lower Bengal plains), South India (Bombay, Khandala, Western Ghats, Kanara, Andamani Is.), Western Himalaya (Nainital, Simla); widely distributed in Southwest Asia and Oceania, Borneo, Burma, China, Fiji, Indonesia, Nepal, Thailand, New Guinea, New

Zealand, North and Central Vietnam, Philippines, Ryuku Is., Sri Lanka, Samoa, South and North America, Tahiti.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257474D, 257475A, 257477B, 257478B, 257483B, 257485B, 257486B (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257490B, 257491D (LWG); Pilibhit Dist., Chimtiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258208C (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258217B, 258218A, 258220B (LWG). **New record to Uttar Pradesh.**

Family - Funariaceae

17. *Physcomitrium eurystomum* Sendtn. in Denkschr. Bayer Bot. Ges. Regensb., 3: 142 (1841). (**Fig. 2L**)

Habitat: On soil; Altitude- 418 ft.

Distribution: Gangetic plains (Lower Bengal, Hooghly, Allahabad), Western Himalaya (Kumaon); Britain, Central and South Africa, China, France, North Vietnam, Taiwan.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257474C (LWG); Pilibhit Dist., Pipariya, N 28°32.471' E 79°54.905', 10.09.2014, *Vinay Sahu* 257493B (LWG).

18. *Entosthodon wichurae* M. Fleisch. in Musci Fl. Buitenz., 2: 481 (1904). (**Fig. 3C**)

Habitat: On soil; Altitude- 536–600 ft.

Distribution: Eastern Himalaya (Meghalaya- Khasi and Jaintia Hills), Western Himalaya (Ranikhet); Burma, Java, Sri Lanka.

Specimens examined: INDIA, Uttar Pradesh, Pilibhit Dist., Barahi Range 69, N 28°38.207' E 80°10.465', 09.09.2014, *Vinay Sahu* 257496B (LWG); Chimtiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258212B (LWG). **New record to Uttar Pradesh.**

Family - Pottiaceae

19. *Barbula indica* (Hook.) Spreng. Steud. Nomencl., 2: 72 (1824). Saito J. Hattori Bot. Lab., 39: 488 (1975). (**Fig. 3 A, B**)

Semibarbula orientalis (Web.) Wijk et Marg., Taxon, 8: 75 (1959); Gangulee, Moss. E. Ind., 3: 717 (1972).

Habitat: On soil, stony wall; Altitude- 353–547 ft.

Distribution: Widely distributed plain area in the country and up to 1000 m in the Himalayas; Nepal, Southeast Asia, Japan, South Africa, New Guinea.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Sankarpur police station, Near Radha Swami Inter College, Kevalpurva, N 27°54.352' E 80°54.259', 09.09.2014, *Vinay Sahu* 257460A, 257462A, 257463A, 257465B (LWG); Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257470B, 257472B (LWG); Khalsa Public School, N28°24.987' E 80°11.207', 10.09.2014, *Vinay Sahu* 257492A (LWG); Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257477C, 257481B, 257486A, (LWG); Near Forest Office, Mala range, Rechaula, N 28°37.070' E 79°54.894', 11.09.2014, *Vinay Sahu* 257494B, 257495C (LWG); Pilibhit Dist., Barahi Range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258204B (LWG); Chimtiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258211A (LWG); Near Amritsar dhabha, Ashram road, 12.09.2014, *Vinay Sahu* 258216A (LWG).

20. *Gymnostomum calcareum* Nees et Hornsch., Bryol. Germ., 1: 153 10f.15 (1823); Gangulee, Moss. E. Ind., 3: 641 (1972). (**Fig. 3D**)

Habitat: On soil, Altitude- 547 ft.

Distribution: Eastern Himalaya, Western Himalaya (Uttarakhand-Mussoorie, Corbett National Park); Africa, Australia, China, Europe, Japan, New Zealand, North Central and South America.

Specimens examined: INDIA, Uttar Pradesh, Pilibhit Dist., Barahi Range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258202A (LWG); Near Gajraula, N 28°31.307' E 79°56.937' 12.09.2014, *Vinay Sahu* 258215B (LWG). **New record to Uttar Pradesh.**

21. *Hydrogonium arcuatum* (Griff.) Wijk et Marg., Taxon, 7: 289 (1958); Gangulee, Moss. E. Ind., 3: 725 (1972).

Habitat: On soil, Altitude- 353 ft.

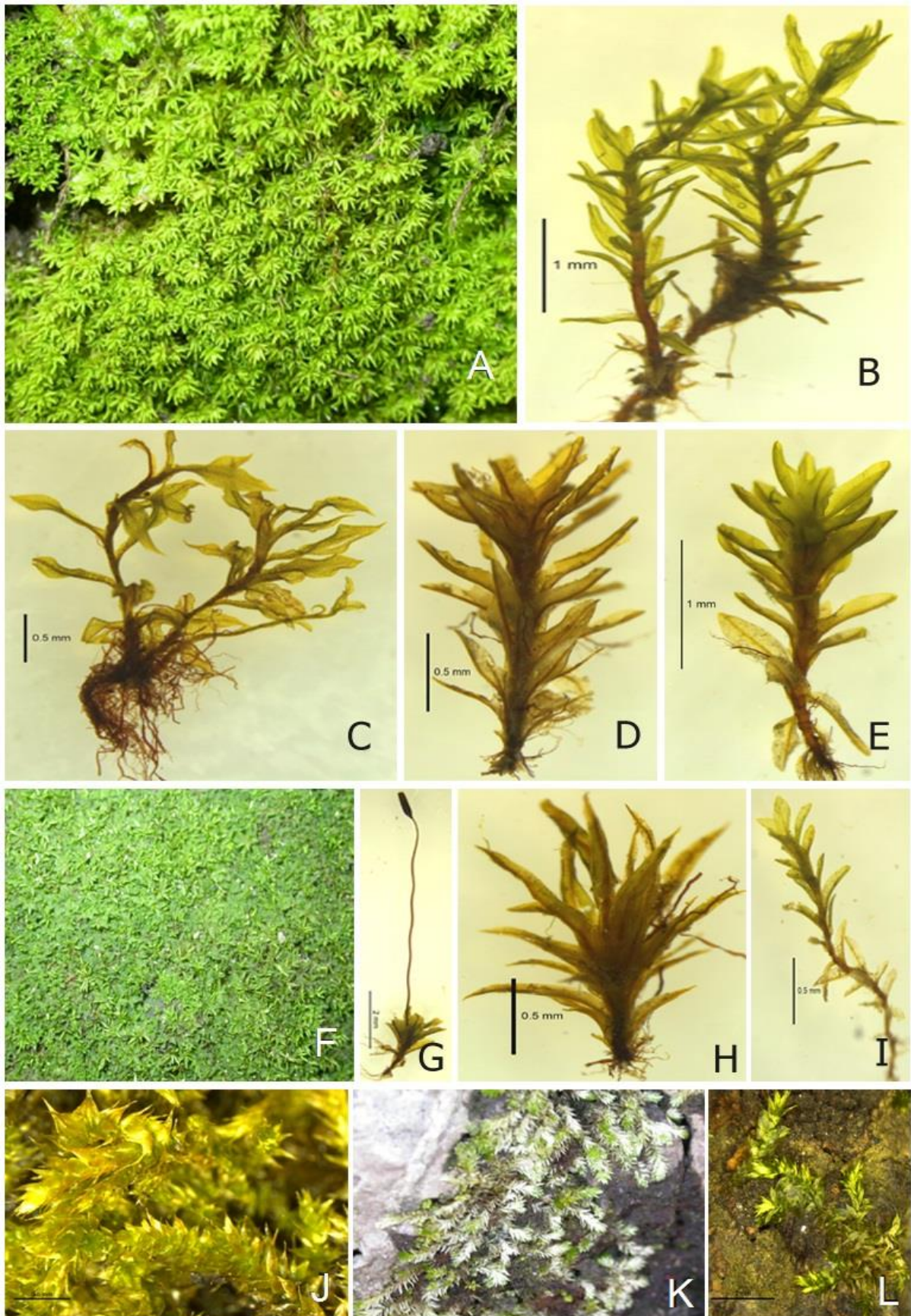


Figure 3. A–B, *Barbula indica*; C, *Entosthodon wichurae*; D, *Gymnostomum calcareum*; E, *Hyophila spathulata*; F–G, *Hyophila nymaniana*; H, *Weissia controversa*; I, *Splachnobryum obtusum*; J, *Trachyphyllum inflexum*; K–L, *Entodontopsis tavoyense*.

Distribution: Central India (Madhya Pradesh, Jharkhand, Orissa), Eastern Himalaya (Assam, Arunachal Pradesh, Meghalaya West Bengal), South India (Tamil Nadu), Western Himalaya (Himachal Pradesh, Kashmir, Uttarakhand); Bhutan, China, East Nepal, Japan, Java, Malaya, Moluca, Myanmar, New Guinea, Philippines, Oceania.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Sankarpur police station, N 27°54.352' E 80°54.259', 08.09.2014, *Vinay Sahu* 257461A (LWG).

22. *Hyophila nymaniana* (Fleisch.) Menzel 22: 198 (1992); Nair M. C. et al., Moss Waynad in W. Ghats 117 (2005). (**Fig. 3F, G**)

Hyophila rosea Williams, Bull. N.Y Bot. Gard., 8: 341 (1914); *H. comosa* Dix. et P. Verd., Arch. Bot., 1: 166 (1927).

Habitat: On soil, stony wall; Altitude- 452–600 ft.

Distribution: Central India (Gujarat), Eastern Himalaya (Meghalaya), Gangetic Plain (Allahabad), Western Himalaya (Uttarakhand, Corbett National Park), South India (Karnataka, Kerala, Tamil Nadu); Nepal, Philippines.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur Kheri Dist., Near Radha Swami Inter College, Kevalpurva, N 27°53.194' E 80°56.046', 08.09.2014, *Vinay Sahu* 257463B, 257465C (LWG); Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257479A (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257487A, 257489A (LWG); Pilibhit Dist., Khalsa Public School, Ruria Puranpur, N 28°24.987' E 80°11.207', 10.09.2014, *Vinay Sahu* 257492B (LWG); Near Forest Office, Mala range, Rechaula, N 28°37.070' E 79°54.894', 11.09.2014, *Vinay Sahu* 257494A (LWG); Barahi Range 69, N 28°38.207' E 80°10.465', 11.09.2014, *Vinay Sahu* 257498B (LWG).

23. *Hyophila spathulata* (Harv.) A. Jaeger Ber. S. Gall. Naturw. Ges., 1871-72: 353 (1873). Gangulee, Moss. E. Ind., 3: 687 (1972). (**Fig. 3E**)

Habitat: On soil; Altitude- 418–480 ft.

Distribution: Gangetic Plain (Allahabad, Delhi), Western Himalaya (Uttarakhand) South India (Tamil Nadu); China, Japan, East and West Nepal, Myanmar, Sri Lanka.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 227477D (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258217A, 258219C, 258220A (LWG).

24. *Weissia controversa* Hedw., Spec. Musc., 67 (1801). Saito J. Hattori Bot. Lab., 39: 426 (1975). (**Fig. 3H**)

Habitat: On soil; Altitude- 480 ft.

Distribution: Western Himalaya (Kashmir, Uttarakhand), South India (Tamil Nadu); Australia, China, Europe, Japan, New Zealand, North Central and South America, Pakistan, Sri Lanka, West Indies.

Specimens examined: INDIA, Uttar Pradesh, Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258220D (LWG). **New record to Uttar Pradesh.**

Family - Splachnaceae

25. *Splachnobryum obtusum* (Brid.) Mull. Hal., Verh. K. K. Zool. Bot. Ges. Wien 19: 503 (1869). (**Fig. 3I**)

S. indicum Hamp. et C. Muell. In Linnaea 37: 174 (1872).

Habitat: On rock, stony wall; Altitude- 485 ft.

Distribution: Gangetic plains (Gangetic Southern Bengal, Howrah, Hooghly, Kolkata, Delhi, Allahabad, Orissa), Western Himalayas (Tehri), South India (Western Ghats); Java, Africa, America, Australia, Burma, Europe, Indonesia, Macaronesia, Philippines, Papua New Guinea. Thailand.

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257467C (LWG); Pilibhit Dist., Near Gajraula, N 28°31.307' E 79°56.937', 11.09.2014, *Vinay Sahu* 258216B (LWG).

Family - Thuidiaceae

26. *Trachyphyllum inflexum* (Harvey) Gepp. in Hiern: Cat. Weln. Afr. Pl. 2, 21: 299 (1901). (**Fig. 3J**)

Habitat: Epiphytic; Altitude- 547 ft.

Distribution: Central India (Madhya Pradesh-Amakantak), Eastern Himalaya (Darjeeling, Khasi Hills, Sikkim), Gangetic plains (Orissa), South India (Palni Hills, Kanara), Western Himalaya (Valley of Flowers, Corbett

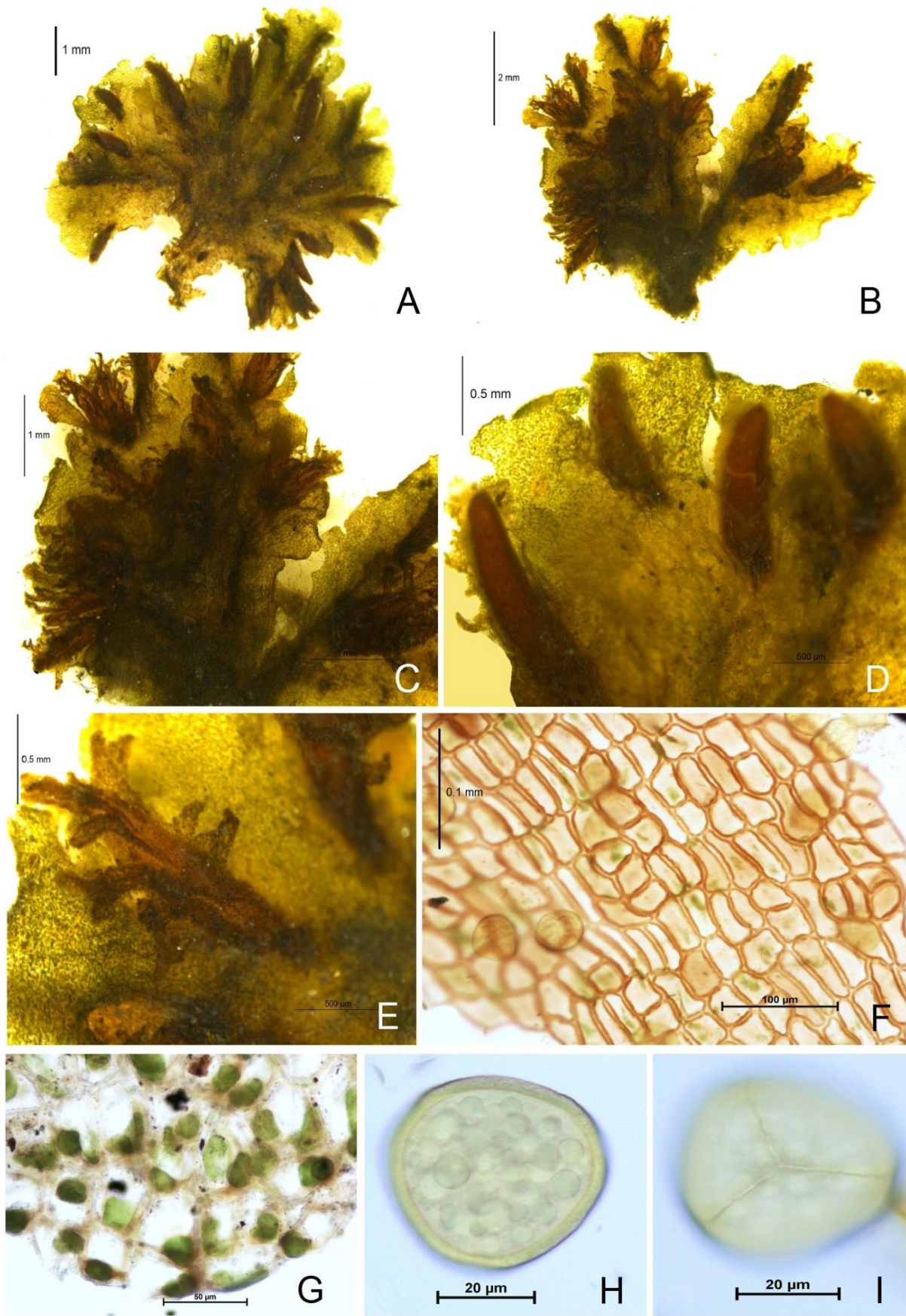


Figure 4. *Notothylas kashyapii*: A–C, Thalli; D, Sporophytes in the apical region; E, Lamellae present on involucre; F, Capsule wall; G, chloroplast; H–I, Spores.

National Park); Australia, Bangladesh, Burma, Central Vietnam, China, Cambodia, Java, Madagascar, Moluccas, Nepal, New Caledonia, Philippines, Thailand.

Specimens examined: INDIA, Uttar Pradesh, Pilibhit Dist., Barahi range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258206B (LWG). **New record to Uttar Pradesh.**

Family - Stereophyllaceae

27. *Entodontopsis tavoyense* (Hook. ex Harv.) W.R. Buck. & R.R. Ireland, *Nova Hedwigia* 41: 105 (1985).

(Fig. 3K, L)

Sematophyllum tavoyense (Hook.) Jaeg.

Habitat: Epiphytic; Altitude- 547 ft.

Distribution: Gangetic plain (Bihar), Western Himalaya (Dehradun, Corbett National Park); South India (Kerala); Bangladesh, East Nepal, Moulmein, Penang, Tavoy.

Specimens Examined: INDIA, Uttar Pradesh, Pilibhit Dist., Barahi range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258205A (LWG). **New record to Uttar Pradesh.**

Hornworts

Family - Notothylaceae

28. *Notothylas indica* Kash. in Kashyap and Dutt in Proc. Lahore Phill. Soc. 4: 49-56 (1925); Asthana & Srivastava in Bryophyt. Biblioth. 42:94 (1991). (Fig. 1G)

Habitat: On soil; Altitude- 485 ft.

Distribution: Gangetic plain (Lucknow, Allahabad), Central India (Pachmarhi, Tikamgarh), South India (Mumbai, Nagpur), Western Himalaya (Dehradun, Mussoorie); Pakistan (Parachhinar), Myanmar (Yangong).

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Gola Forest, N 28°03.533' E 80°29.538', 09.09.2014, *Vinay Sahu* 257468A, 257471B, 257472A (LWG).

29. *Notothylas kashyapii* D.K. Singh, in Singh and Semwal in India J. For. 23(4): 386 (2000).

Habitat: On soil; Altitude- 418–600 ft. (Fig. 4A-I)

Distribution: Western Himalaya (Uttarakhand-Dehradun).

Specimens examined: INDIA, Uttar Pradesh, Lakhimpur-Kheri Dist., Salempur Forest Division, Malani Range, N 28°27.337' E 80°29.556', 09.09.2014, *Vinay Sahu* 257474A, 257477A, 257478C (LWG); Lalapur, near forest nursery, N 28°10.254' E 80°19.395', 10.09.2014, *Vinay Sahu* 257488A (LWG), Pilibhit Dist., Barahi Range 69, N 28°38.207' E 80°10.465', 11.09.2014, *Vinay Sahu* 257496A, 257497B (LWG); Barahi Range 72, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258203B (LWG); Chintiya Puranpur, Barahi range, N 28°37.006' E 080°11.5', 11.09.2014, *Vinay Sahu* 258213B (LWG); Shahjahanpur Dist., Near Khutar Forest, N 28°18.768' E 80°13.827', 12.09.2014, *Vinay Sahu* 258218B (LWG). **New record to Uttar Pradesh.**

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