

Contribution to the liverwort and hornwort flora of Jharkhand

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झारखंड के लिवरवर्ट एवं हार्नवर्ट वनस्पतिजात में योगदान

सुशील कुमार सिंह एवं शशि कुमार

सारांश

इस अध्ययन में लिवरवर्ट्स की नौ जातियों, *रिकसिया केवरनोसा* हाफम., *रि. फ्रास्टाई* आस्टिन, *रि. ह्यूबेनेरियाना* लिंडेन., *रि. मिलेनोस्पोरा* कश्यप, *रि. पर्सोनी* सुल्तान खान, *रि. सोरोकार्पा* बिश्च., *सायथोडियम केवरनरम* कुंज एवं लेहम., *मार्केशिया पप्पियाना* लेहम. उपजाति *रोबुस्टा* (स्टेफ.) बिश्चल. तथा हार्नवर्ट की एक जाति *नोटोथैलस कश्यपाई* डी.के. सिंह झारखंड राज्य से पहली बार अभिलेखित कर वर्णित की गयी हैं।

ABSTRACT

Present study reports nine species of liverworts namely, *Riccia cavernosa* Hoffm., *R. frostii* Austin, *R. glauca* L., *R. huebeneriana* Lindenb., *R. melanospora* Kashyap, *R. perssonii* Sultan Khan, *R. sorocarpha* Bisch., *Cyathodium cavernarum* Kunze ex Lehm., *Marchantia pappeana* Lehm. subsp. *robusta* (Steph.) Bischl. and one hornwort *Notothylas kashyapii* D.K. Singh for the first time from Jharkhand state.

Keywords: *Cyathodium*, Jharkhand, *Marchantia*, New Record, *Notothylas*, *Riccia*

INTRODUCTION

Jharkhand is a mineral rich state, with a geographical area of 79,710 km², of which 28.72% area is under forest cover. The area has a tropical climate with annual rainfall of about 900 mm and the temperature ranging between 4–47°C. Due to diverse physiographic and climatic conditions, the state possesses a unique plant diversity sprawling across tropical dry deciduous, moist deciduous, dry peninsular and dry mixed deciduous forest. As compared to phanerogams (which is apparently better explored), cryptogamic flora is poorly documented for the State. As

far as liverwort and hornwort diversity is concerned, the state remains almost *Terra incognita*. Only four species, namely *Riccia billardiarii* Mont. & Nees, *Plagiochasma appendiculatum* Lehm. & Lindenb., *Cololejeunea latilobula* (Herzog) Tixier and *Spruceanthus minutilobula* (Udar & U.S. Awasthi) Sushil K. Singh were reported from Jharkhand (Singh & al., 2016; Singh & Kumar, 2016). One of the authors (SK) recently (2015–2017) collected several specimens from Rajmahal Hills – a world famous place for fossil. Careful study of these collections reveal the presence of 10 noteworthy species from the state including *Riccia cavernosa* Hoffm., *R. frostii* Austin, *R. glauca* L.,

R. huebeneriana Lindenb., *R. melanospora* Kashyap, *R. perssonii* Sultan Khan, *R. sorocarpa* Bisch. (Ricciaceae), *C. cavernarum* Kunze ex Lehm. (Cyathodiaceae), *Marchantia pappeana* Lenm. subsp. *robusta* (Steph.) Bischl. (Marchantiaceae) and *Notothylas kashyapii* D.K. Singh (Notothyladaceae). All the ten species are recorded here for the first time from the state.

TAXONOMIC TREATMENT

LIVERWORTS

RICCIACEAE

1. ***Riccia cavernosa*** Hoffm., Deutschl. Fl. 2: 95. 1796 emend. Raddi, Opusc. Sci. (Bologna) 12: 351. 1818.

This is most common species found in Indian plains during winter season. This species can be recognised by its spongy thallus which is almost up to 10 mm long and up to 3 mm broad with inconspicuous sulcus (except near apex) and Ricciella - type thallus anatomy. The spores are brown, globose to subglobose, anisopolar, 65–90 µm in diameter with the distal surface showing prominent lamellae incrustated with granules and puncti forming incomplete reticulations, and the proximal surface with conspicuous tri-radiate mark, often with granules on each face, simple or branched and anastomosing ridges which occasionally form complete reticulum. It closely resembles *R. crystallina* L., but distinctly differs in having 6–10 complete reticulations on distal surface in the latter.

Distribution: India [Himachal Pradesh, Jharkhand-present study, Maharashtra, Madhya Pradesh, Nagaland, Rajasthan, Uttar Pradesh, West Bengal], Bangladesh, Iran, Nepal, Pakistan, Russia, Africa, Australia, Europe, Macronesia, North & South America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Sahibganj district, near Amjhor riverside, terrestrial, 24°50'46.61" N, 87°42'29.17" E, 40 m, 21.11.2015, *Shashi Kumar* JH – 18 (ASSAM); near Singhi dalan, Ganga riverside, terrestrial, 25°03'20.70" N, 87°50'01.02" E, 32 m, 14.01.2017, *Shashi Kumar* JH – 55 B (ASSAM).

2. ***Riccia frostii*** Austin, Bull. Torrey Bot. Club 6: 17. 1875.

This is another most common species of *Riccia* in India, distributed in plains along rivulet edges, canal sides, garden beds, river beds, etc., especially in sandy soils during winter. The plants somewhat look like *R. cavernosa* but less cavernose and much elongated. The

reddish male plants readily separate it from other species under the genus. The spores are highly characteristic, being lamellate on both proximal and distal surfaces.

Distribution: India [Assam, Bihar, Chhattisgarh, Delhi, Jammu & Kashmir, Jharkhand-present study, Kerala, Maharashtra, Manipur, Madhya Pradesh, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal], Bangladesh, China, Iran, Nepal, Pakistan, Russia, Turkey, Africa, Europe, North & South America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Sahibganj district, near Amjhor riverside, terrestrial, 24°50'46.61" N, 87°42'29.17" E, 40 m, 21.11.2015, *Shashi Kumar* JH – 13, 19, 23 (ASSAM); near Amjhor river side to near Chutia riverside, terrestrial, 24°50'26.54" N, 87°42'30.97" E, 38 m, 23.03.2016, *Shashi Kumar* JH – 26, 27 (ASSAM).

3. ***Riccia glauca*** L., Sp. Pl. 1139. 1753. var. *glauca*

This is a less known species in Indian bryology. It is very closely related to *R. sorocarpa* which, however, distinctly differ in having 2-layered epidermis (mamillate, disorganising upper layer and thick-walled persistent lower layer) as against single-layered epidermis in *R. glauca*.

Distribution: India [Assam, Jharkhand-present study, Maharashtra, Odisha], China, Iran, Japan, Korea, New Zealand, Russia, Taiwan, Turkey, Africa, Europe, Macronesia, North America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Sahibganj district, Barharwa, near Bindudham temple, terrestrial, 24°51'55.02" N, 87°45'46.36" E, 61 m, 02.10.2016, *Shashi Kumar* JH – 39, 46B, 48, 49B (ASSAM).

4. ***Riccia huebeneriana*** Lindenb., Nov. Actorum Acad. Caes. Leop. - Carol. German. Nat. Cur. 18: 504. 1836.

This is most common species in Northeast India at elevation of 500–1200 m, though it is least mentioned in the published literatures. The plants grow usually in caespitose patches often forming rosettes. It can be easily differentiated from other species in having bright green, narrowly elongated, deeply sulcate *Ricciella* - type thalli which possess golden yellow, subglobose to triangular and anisopolar spores measuring 60–85 µm in diameter with distal surface having 6–8 reticulations across.

Distribution: India [Assam, Goa, Jharkhand-present study, Nagaland, Karnataka, Kerala, Madhya Pradesh,

Sikkim, Uttar Pradesh, West Bengal], China, Japan, Korea, Philippines, Russia, Sri Lanka, Africa, Europe, Macronesia, North America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Pakur district, near Simlong riverside, terrestrial, 24°50'03.87" N, 87°42'22.51" E, 39 m, 03.10.2016, *Shashi Kumar* JH – 50, 52; near Amjhor riverside to near Chutia riverside, terrestrial, 24°50'03.87" N, 87°42'22.51" E, 39 m, 16.01.2017, *Shashi Kumar* JH – 75 (ASSAM).

5. *Riccia melanospora* Kashyap, Liwerw. W. Himal. 1: 94. 1929.

This species is distributed in Indian subcontinent only (Singh & al., 2016). This is characterized by oblong-obovate robust thalli with inconspicuous cilia and comparatively larger spores (80–100µm) with 10–15 reticulation across the diameter on distal surface.

Distribution: India [Jammu & Kashmir, Jharkhand-present study, Maharashtra, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal], Bangladesh, Pakistan (Singh & al., 2016 and literature therein).

Specimen examined: India, Jharkhand, Rajmahal Hills, Sahibganj district, Barharwa, near Bindudham temple, terrestrial, 24°51'55.02" N, 87°45'46.36" E, 61 m, 02.10.2016, *Shashi Kumar* JH – 42 (ASSAM).

6. *Riccia perssonii* Sultan Khan, Svensk Bot. Tidskr. 49: 433. 1955.

This is a very less known species reported from Indian subcontinent and Africa. In India also it is so far known from Gangetic plains only. It can be easily distinguished by its somewhat cavernose, yellowish green thallus and characteristic spores always united in isobilateral tetrads and surface with comparatively long spines (10–15 µm). *R. curtisii* (James ex Austin) Austin closely resembles this species, but differs in spore morphology. The spores in *R. curtisii* are joined into tetrahedral tetrads and the spines are comparatively smaller.

Distribution: India [Jharkhand-present study, Uttar Pradesh, West Bengal], Bangladesh, Africa (Singh & al., 2016 and literature therein).

Specimen examined: India, Jharkhand, Rajmahal Hills, Sahibganj district, near Amjhor riverside, terrestrial, 24°51'00.77" N, 87°42'52.66" E, 39 m, 20.10.2015, *Shashi*

Kumar JH – 04; Near Amjhor riverside to near Chutia riverside, terrestrial, 24°50'03.87" N, 87°42'22.51" E, 39 m, 16.01.2017, *Shashi Kumar* JH – 67, 69 A, 71, 76 A; terrestrial, 24°49'52.61" N, 87°42'15.42" E, 39 m, 27.02.2017, *Shashi Kumar* JH – 78 A, 79 (ASSAM).

7. *Riccia sorocarpa* Bisch., Nov. Actorum Acad. Caes. Leop. - Carol. German. Nat. Cur. 17: 1053. 1835 var. *sorocarpa*

Distribution: India [Himachal Pradesh, Jharkhand-present study, Tamil Nadu, Uttarakhand, West Bengal], Bangladesh, China, Hawaii, Iran, Japan, Korea, New Zealand, Russia, Sri Lanka, Turkey, Africa, Australia, Europe, Macronesia, North & South America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Sahibganj district, near Amjhor riverside to near Chutia riverside, terrestrial, 24°50'03.87" N, 87°42'22.51" E, 39 m, 16.01.2017, *Shashi Kumar*, JH – 72, 75B (ASSAM).

CYATHODIACEAE

8. *Cyathodium cavernarum* Kunze ex Lehm. in Lehm. & Lindenb., Nov. Stirp. Pug. 6: 18. 1834.

This is most common species of the genus *Cyathodium* Kunze ex Lehm. in India. The plants can be easily visualised in plains of northern India and Western Ghats where it is abundantly found in moist and shady places, in crevices or bricks of old walls. The species can be easily differentiated by its very shiny frequently branched thalli bearing smooth or non hairy, bilabiate involucre with pigmented lining of mouth and baculate to somewhat spinose sporoderm.

Distribution: India [Andhra Pradesh, Goa, Gujarat, Jammu & Kashmir, Jharkhand-present study, Kerala, Maharashtra, Meghalaya, Madhya Pradesh, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, West Bengal], Bangladesh, China, Indonesia, Japan, Myanmar, Nepal, Sri Lanka, Africa, Australia, North & South America (Singh & al., 2016 and literature therein).

Specimen examined: Jharkhand, Rajmahal Hills, Sahibganj district, Moti jharna, Siva cave, terrestrial, 25°12'52.94" N, 87°44'26.36" E, 32 m, 18.11.2015, *Shashi Kumar* JH – 08, 09, 10 (ASSAM); Pakur district, near Simlong riverside, terrestrial, 24°45'12.53" N, 87°26'38.72" E, 112 m, 31.08.2016, *Shashi Kumar* JH – 38 (ASSAM).



Fig. 1: 1. *Riccia cavernosa* Hoffm.; 2. *Riccia frostii* Austin; 3. *Riccia glauca* L. var. *glauca*; 4. *Riccia huebeneriana* Lindenb.; 5. *Riccia melanospora* Kashyap; 6. *Riccia perssonii* Sultan Khan; 7. *Riccia sorocarpa* Bisch.; 8. *Marchantia pappeana* subsp. *robusta* (Steph.) Bischl.; 9. *Cyathodium cavernarum* Kunze ex Lehm.; 10. *Notothylas kashyapii* D.K. Singh.

MARCHANTIACEAE

9. *Marchantia pappeana* Lehm. subsp. ***robusta*** (Steph.) Bischl., Bryophyt. Biblioth. 45: 91. 1993. *Marchantia robusta* Steph., Candollea 14: 111. 1953.

It is closely related to *M. emarginata* Reinw. & al. subsp. *emarginata* and *M. papillata* Raddi subsp. *grossibarba* (Steph.) Bischl. But, both the species distinctly differ from the species in discussion in having deeply divided female receptacles with conspicuous median projections; lobes convex basally, broadened apically (female receptacles are shallowly divided, without or with shallow median projections; lobes not convex basally, not broadened apically in *M. pappeana* subsp. *robusta*) (Singh & Singh, 2013). *M. pappeana* subsp. *robusta* differs further from the allied species in its robust thalli, large ventral scales with angular or bluntly toothed margins, and 7-11 rayed female receptacles.

Distribution: India [Jammu & Kashmir, Jharkhand-present study, Kerala, Tamil Nadu], Sri Lanka (Singh & al., 2016 and literature therein).

Specimen examined: India, Jharkhand, Rajmahal Hills, Sahibganj district, near Amjhor riverside to near Chutia riverside, terrestrial, 24°49'52.61" N, 87°42'15.42" E, 39 m, 27.02.2017, Shashi Kumar JH – 81, 82 (ASSAM).

HORNWORTS

NOTOTHYLADACEAE

10. *Notothylas kashyapii* D.K. Singh in D.K. Singh & Semwal, Indian J. Forest. 23: 386. 2000.

This is an endemic species, described from Uttarakhand only, although we have observed it from other places in Northeast India too during recent field explorations. It is

closely allied to *Notothylus pfleidereri* Udar & D.K. Singh, but differs in lamellate thalli, emergent sporogonia, cells of outer capsule wall with wide lumen and total absence of pseudoelaters, as against smooth thalli, fully immersed sporogonia, outer capsule wall with comparatively narrow lumen and pseudoelaters (if present) without thickenings in the latter (Singh, 2002).

Distribution: India [Uttarakhand, Jharkhand-present report], endemic (Singh & al., 2016 and literature therein).

Specimen examined: India, Jharkhand, Rajmahal Hills, Sahibganj district, Barharwa, near Bindudham temple, terrestrial, 24°51'55.02" N, 87°45'46.36" E, 61 m, 02.10.2016, Shashi Kumar JH – 43, 45, 46C (ASSAM).

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