

## THE GENUS *CALYCULARIA* (MARCHANTIOPHYTA) IN KERALA PART OF THE WESTERN GHATS

C. N. MANJU<sup>1\*</sup>, V. K. RAJILESH<sup>2</sup>, K. M. DEEPA<sup>1</sup> and R. PRAKASHKUMAR<sup>2</sup>

View metadata, citation and similar papers at [core.ac.uk](http://core.ac.uk)

provided by Re

<sup>2</sup>Malabar Botanical Garden, Olavanna, Kozhikode-14, Kerala, India

(Received 29 January, 2015; Accepted 10 May, 2015)

The genus *Calycularia* of Calyculariaceae is reported for the first time from the Kerala part of the Western Ghats along with the species *C. crispula*.

Key words: *Calycularia*, Calyculariaceae, Kerala, new record, Western Ghats

### INTRODUCTION

The genus *Calycularia* belongs to the monotypic family Calyculariaceae (Crandall-Stotler *et al.* 2008). The genus includes two accepted species (Konstantinova and Mamontov 2010), the type species of the genus, *Calycularia crispula* Mitt. described by Mitten in 1861 based on the specimen collected by J. D. Hooker in Sikkim Himalaya and *Calycularia laxa* Lindb. et Arnell described by Lindberg and Arnell in 1889 from the Russian Arctic. Now the distribution of the species *C. crispula* extends to mountains of the tropics and subtropics and *C. laxa* found in the north and in the mountains of Siberia and the far east of Russia. Konstantinova and Mamontov (2010) studied more than 135 species from different herbaria and distribution of *C. crispula* is reduced from some areas and the distribution of *C. laxa* is extended. This genus was described in India from Sikkim Himalaya by Kashyap (1932) and later this species was reported from eastern parts of India (Pande and Udar 1956, Singh and Singh 2010b, Singh *et al.* 2008) and from the Western Ghats of Tamil Nadu (Daniels *et al.* 2014). But most of the authors have placed this genus in Allisoniaceae. Recently, based on molecular data, it has been separated into the

monotypic family Calyculariaceae (Crandall-Stotler *et al.* 2008). This genus has not been reported from Kerala, which occupies the major portion of the Western Ghats. Hence the report of this species from the recently constituted Mathikettan Shola National Park in the Western Ghats is an addition of this genus along with the species *C. crispula*. We could also collect this species from Valparai of Coimbatore district in Tamil Nadu.

The genus *Calycularia* is having specific characters, which distinguish it from most genera of the simple thalloid hepatics in having lamellate and usually purplish lamellate ventral scales. But there are several characters, which will confuse *Calycularia* with *Pellia* and *Aneura* (Konstantinova and Mamontov 2010).

### *Calycularia* Mitt.

*Calycularia* Mitt., J. Linn. Soc. 5(1): 122 (1861) (after Konstantinova and Mamontov 2010)

Type species: *Calycularia crispula* Mitt.

Plants large, 1.5–3 cm long and 0.5–1.2 cm wide, thallus dark greenish, strongly undulating and crispate margins, branching terminal, numerous pale brownish rhizoids restricted to midrib, apical portion of the thallus strongly recurved back to the dorsal surface, midrib rather distinct, dorsally flat or concave, ventrally convex, 8–20 cells thick abruptly tapering into unistratose margin, 30–50 cells wide. Epidermal cells on dorsal side obliquely oriented and gradually decreasing from midrib toward the thallus margin, whereas on ventral side they are increasing from midrib toward the thallus margin. Cross section with one layer of dorsal epidermal cells smaller than inner cells, central strand lacking, ventral epidermis in 1–4 layers of small cells with relatively incrassate light purple or brownish walls. Ventral scales numerous, restricted to costal area and most abundant towards an apical notch, purplish red or sometimes colourless, straight or recurved to arcuate, 2–6(–8)-seriate at base, abruptly tapering into an uniseriate tip with marginal teeth or cilia. Oil bodies minute, 1.0–3.7  $\mu\text{m}$ , homogeneous or from 2–4(–5) granules, 12–58 per cell.

Dioicous. Gametangia on the dorsal surface of thallus. Male plants usually smaller than female, plants with dorsal scales mostly in several rows along midrib or (rarely) scattered over the entire apical portion of the thallus. Androecia subtended by unistratose bracts, which are erect or concave, lamelliform, variable in shape and size, lacinate-dentate, each bract with 1–4 sessile globose antheridia, antheridial stalk multicellular. Archegonia aggregated in well-defined or diffuse clusters and surrounded by slender scales. The archegonial scales yellowish red or colourless, erect, arcuate, or prostrate, similar in shape to ventral scales, linear to lanceolate, with marginal teeth

or cilia. Pseudoperianth purplish red to red-brown or colourless, large, up to 6 mm high and up to 5 mm wide, usually at apical part of the thallus or rarely medially, infundibuliform, bell-shaped or inflated-cylindrical, in cross section rounded, at base multistratose, 3–4 cells thick, near mouth one layered and plicate, pseudoperianth mouth with 3–4 massive laciniate or ciliate lobes. Cells of lobes (40–)50–60  $\mu\text{m}$  wide, (50–)65–100  $\mu\text{m}$  long.

Key to the species of *Calycularia*  
(after Konstantinova and Mamontov 2010)

- 1a Thallus deeply divided towards midrib on lobe-like structures. The costal region is relatively distinctly separated and more or less abruptly tapers into a 1–2 cell thick “wing”. Lobes of the pseudoperianth mouth laciniate with lacinia biseriate (or more) almost to the apex, or rarely with uniseriate teeth 1–2 cells long *C. crispula*
- 1b Thallus is wavy but not to the extent of forming lobe-like structures. The costal region is not distinctly separated from the remaining part of the thallus and gradually tapers into a 2–1 cell thick part. Lobes of the pseudoperianth mouth laciniate-ciliate with cilia 7–13 cells long and uniseriate almost from the base *C. laxa*

***Calycularia crispula* Mitt.**

(Fig. 1A–S)

*Calycularia crispula* Mitt., J. Linn. Soc. 5(1): 122 (1861); Konstantinova and Mamontov (2010); Daniels *et al.* (2014).

= *C. birmensis* Steph., Bull. Herb. Boissier 16: 4 (1900); Spec. Hepat. 1: 359.

= *C. compacta* Kashyap, Liverworts of the Western Himalayas and the Panjab plain 2: 105 (1932).

= *C. formosana* Horik., J. Sci. Hiroshima Univ., Ser. B (Bot.) 2: 137 (1934).

= *C. golae* Gerola, Lavori di Botanica, Torino 12: 473 (1947).

Thallus dark greenish, translucent, 1–3 cm long, 0.6–0.9 cm wide, grows on overlapping patches, prostrate, dorsiventral, flat, deeply divided towards midrib on lobe-like structures, 1–2 times furcated, ventral shoots arise from midrib; rhizoids light pinkish to colourless, numerous; midrib prominent, distinctly separated, more or less abruptly tapering into a 1–2 cells thick wing, midrib in cross section 8–20 cells high, unistratose margin 35–60 cells rows wide, midrib cells in transverse section rounded-hexagonal, in longitudinal section rectangular; cells of ventral epidermis of the midrib 22–40  $\mu\text{m}$  wide, 30–40  $\mu\text{m}$  long, weakly differ from inner cells; cells of ventral epidermis of the wings 36–58  $\mu\text{m}$  wide, 44–78  $\mu\text{m}$  long; dorsal cells above midrib 16–26

$\mu\text{m}$  wide, 38–80  $\mu\text{m}$  long, dorsal cells along midrib 32–58  $\mu\text{m}$  wide, 50–90  $\mu\text{m}$  long, dorsal cells of wings 48–60  $\mu\text{m}$  wide, 50–70  $\mu\text{m}$  long; cells of unistratose margins 34–50  $\mu\text{m}$  wide, 52–86  $\mu\text{m}$  long; ventral scales hyaline, purplish or purplish red, straight or recurved, 400–500  $\mu\text{m}$  long, 138–147  $\mu\text{m}$  wide, base

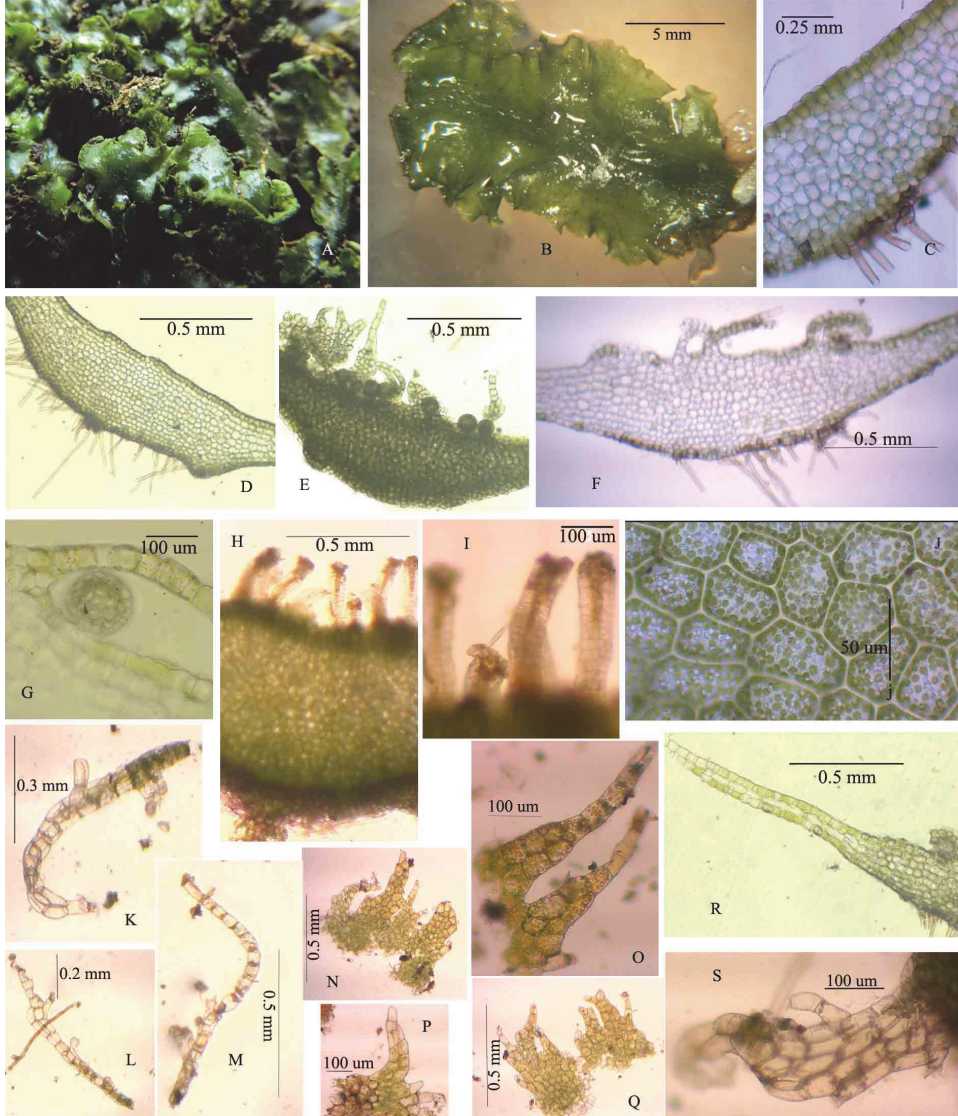


Fig. 1. *Calycularia crispula* Mitt. A = habit; B = single plant enlarged; C–D = cross section of thallus; E–F = antheridia at the dorsal surface along with dorsal scales; G = antheridia enlarged; H = cross section of female thallus; I = archegonia enlarged; J = polygonal cells at surface view; K–M = female scales; N–Q = dorsal scales; R = cross section of thallus margin; S = ventral scale

of ventral scale 4–6 cells broad, tip unistratose; oil bodies 6–34 per cell. Dioicous. Archegonia formed in dense clusters, protected by prostrate scales. Archegonial scales elongated, hyaline, 750–950  $\mu\text{m}$ , Antheridia dorsal, formed in several rows along midrib and are subtended by lamelliform bracts, antheridia is sessile and globose.

Ecology: *C. crispula* is a mountain species restricted to rather high altitude areas. It is earlier reported from 1,300 m alt. in Taiwan to 2,700 m alt. in Africa and 3,500 m alt. in Himalaya. From the Western Ghats Daniels *et al.* (2014) reported this species from Anamalais of Coimbatore district, which is 1,200 m a.s.l. The present collection from two localities of the Western Ghats one from 1,540 m altitude of montane wet temperate forests and other from 950 m a.s.l. in moist deciduous forest, attached to the bark of trees and on rocks, it also occurs on decaying logs, moist soil, in deep crevices and on shaded humus covered cliffs in river valleys.

Distribution: Asia: India, Nepal (Kashyap 1932, Pande and Udar 1956, Singh and Singh 2010a, b, Singh *et al.* 2008), Western Ghats, Tamil Nadu, Anamala hills (Daniels *et al.* 2014), Valparai (present collection), Kerala, Mathikettan Shola National Park (present collection); China (Konstantinova and Mamontov 2010); Bhutan (Long and Grolle 1990); Myanmar, Thailand (Konstantinova and Mamontov 2010, Schuster 1983); Taiwan (Konstantinova and Mamontov 2010, Piippo 1990). – East Africa: Ethiopia, Tanzania, Zambia, Malawi (Jones 1985, Wigginton and Grolle 1996). – North America: Mexico (Grolle 1980); Costa Rica (Dauphin 2005). Earlier reports from Japan (Inoue 1976), Korea (Choi 2009) and Canada (Davison and Smith 1992) were revised and commented that the species occurring in Japan, Korea and Canada is *C. laxa* (Konstantinova and Mamontov 2010).

Specimens examined: India, Kerala, Idukki dit., Mathikettan Shola National Park (1,540 m) Rajilesh, V. K. (11563) (MBG & 3923, 3925 ZGC); Tamil Nadu, Coimbatore, Valparai (950 m) Manju, C. N. & Rajesh, K. P. (4002) (ZGC).

\*

*Acknowledgements* – Authors are thankful to the authorities of the Zamorin's Guruvayurappan College and Malabar Botanical Garden, Kozhikode for providing support and facilities. We are thankful to Dr D. K. Singh, Botanical Survey of India for sending us his publications on *Calycularia crispula*. Thanks are also due to the officials of the Kerala Forest Department, for the permission and support extended during the field studies.

## REFERENCES

Choi, S. S. (2009): *The Hepaticae (liverworts) flora of Mt Deogyu in Korea*. – Seoul, 201 pp.

- Crandall-Stotler, B., Stotler, R. E. and Long, D. G. (2008): *Morphology and classification of the Marchantiophyta*. – In: Goffinet, B. and Show, A. J. (eds): *Bryophyte biology*, 2 ed. Cambridge, pp. 1–54.
- Daniels, A. E. D., Kariyappa, K. C. and Sreebha, R. (2014): On the occurrence of *Calycularia crispula* Mitt. (Calyculariaceae) in the Western Ghats, India. – *Acta Bot. Hung.* **56**(3–4): 293–297. <http://dx.doi.org/10.1556/ABot.56.2014.3-4.5>
- Dauphin, G. (2005): Catalogue of Costa Rican Hepaticae and Anthocerotae. – *Bryoph. Div. Evol.* **26**: 141–218. <http://dx.doi.org/10.11646/bde.26.1.17>
- Davison, P. and Smith, D. K. (1992): *Calycularia crispula* (Hepaticae) in the Aleutian Islands and Pacific Northwest of North America. – *Bryologist* **95**: 266–269. <http://dx.doi.org/10.2307/3243482>
- Grolle, R. (1980): Miscellanea Hepaticologica 201–210. – *J. Bryol.* **11**: 325–334.
- Inoue, H. (1976): *Illustrations of Japanese Hepaticae* 2: 106–109.
- Jones, E. W. (1985): African hepatics XXXV. Some new or little-known species and some noteworthy records. – *J. Bryol.* **13**: 497–508.
- Kashyap, S. R. (1932): *Liverworts of the western Himalayas and the Panjab Plain*. Vol. 2. – University of Panjab, Lahore, 137 pp.
- Konstantinova, N. A. and Mamontov, Yu. S. (2010): A revision of the genus *Calycularia* Mitt. (Calyculariaceae, Marchantiophyta). – *Arctoa* **19**: 117–130. <http://dx.doi.org/10.15298/arctoa.19.09>
- Lindberg, S. O. and Arnell, H. W. (1889): Musci Asiae Borealis. – *Kongl. Svenska Vetensk.-Akad. Handl.* **23**(10): 1–163.
- Long, D. G. and Grolle, R. (1990): Hepaticae of Bhutan 2. – *J. Hattori Bot. Lab.* **68**: 381–440.
- Mitten, W. (1861): Hepaticae Indiae Orientalis. – *J. Linn. Soc. Botany* **5**(1): 89–128. <http://dx.doi.org/10.1111/j.1095-8312.1860.tb01045.x>
- Pande, S. K. and Udar, R. (1956): Studies in Indian Metzgerineae. 3. *Calycularia crispula* Mitten. – *Phytomorphology* **6**: 331–346.
- Piippo, S. (1990): Annotated catalogue of Chinese Hepaticae and Anthocerotae. – *J. Hattori Bot. Lab.* **68**: 1–192.
- Schuster, R. M. (1983): *Phytogeography of the Bryophyta*. – In: Schuster, R. M. (ed.): *New manual of bryology*. Hattori Bot. Lab., Nichinan, Vol. 1, pp. 463–626.
- Singh, D. K., Singh, D. and Dey, M. (2008): *A catalogue of the Hepaticae and Anthocerotae of Sikkim*. – In: Mohamed H., Baki, B. B., Nasrulhag-Boyce, A. and Lee, P. K. I. (eds): *Bryology in the new Millennium*. University of Malaya, Kuala Lumpur, pp. 93–135.
- Singh, S. K. and Singh, D. K. (2010a): *Scanning electron microscopic studies on sporoderm of some liverworts and hornworts*. – In: Mohamed, H., Baki, B. B., Nasrulhag-Boyce, A. and Lee, P. K. I. (eds): *Bryology in the new Millennium*. University of Malaya, Kuala Lumpur, pp. 291–317.
- Singh, S. K. and Singh, D. K. (2010b): A catalogue of the liverworts and hornworts of Himachal Pradesh, India. – *Arch. Bryol.* **61**: 1–13.
- Wigginton, M. J. and Grolle, R. (1996): Catalogue of the Hepaticae and Anthocerotae of Sub-Saharan Africa. – *Bryophyt. Biblioth.* **50**: 1–267.