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COLOLEJEUNEA MANILALIA (LEJEUNEACEAE, MARCHANTIOPHYTA), A NEW SPECIES FROM THE WESTERN GHATS OF INDIA

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Cololejeunea manilalia sp. nov., an epiphyllous leafy liverwort, collected from the high altitude, tropical wet evergreen shola (cloud forest) of the New Amarambalam Reserved Forest in the Western Ghats of India is described and illustrated.

Key words: *Cololejeunea manilalia*, India, Kerala, leafy liverwort, Lejeuneaceae, New Amarambalam, Western Ghats

INTRODUCTION

The New Amarambalam Reserved Forest, located in the Nilgiri Biosphere Reserve with an area of more than 260 km^2, is one of the most notable areas in the Western Ghats of Northern Kerala for its unique assemblage of floristical elements. It lies in contiguous with the Mukuruthi National Park of the Tamil Nadu. The floristical diversity of the area has been explored by Sharma *et al.* (2002), and reported the occurrence of 305 tree species with 212 genera and 73 families. Later Jayakumar (2005) and Jayakumar and Nair (2005) reported 1,135 taxa of angiosperms with 644 genera and 136 families. All the earlier studies in this area had been concentrated on its angiosperm diversity only. A new moss, *Symphysodontella madhusoodananii*, was reported from the area by Manju and Rajesh (2012).

Cololejeunea is a large hepatic genus in tropical and sub tropical regions, and most of them prefer epiphyllous habitat. The members are characterised by the absence of underleaves. About 345 valid species of *Cololejeunea* are reported from the world (Asthana and Srivastava 2003, Pócs 1996, Pócs *et al.*

2014, Singh and Pócs 2016, Singh and Nath 2007, www.discoverlife.org/20/q). In India it is represented by 42 species (Asthana and Srivastava 2003, Day and Singh 2012, Day *et al.* 2010, Singh and Nath 2007).

In the course of our recent studies on the family Lejeuneaceae of the Western Ghats, we found a new taxa of the genus *Cololejeunea* from the *Shola* forests (Southern Montane Wet Temperate Forests) of the New Amarambalam Reserved Forest in the Malappuram District of Kerala state. It is characterised by distantly arranged reniform leaves, absence of prominent vitta and intermediate nodular thickenings of the median cells, and is described here as *Cololejeunea manilalia* sp. nov.

Key to the related species of *Cololejeunea manilalia*

1a	Leaves imbricate, stylus present	2
1b	Leaves distantly arranged, stylus absent	3
2a	Vitta present, 3–4-celled, uniseriate; gynoecium on short lateral branches	*C. indica*
2b	Vitta absent; gynoecium on terminal branches	*C. spinosa*
3a	Leaf ovate-oblong, apex subacute, leaf lobule inflated, bilobed, first tooth small, single-celled, second tooth also single-celled; absence of intermediate nodular thickenings in median cells	*C. nilgiriensis*
3b	Leaves reniform, apex obtuse, leaf lobule slightly inflated, first tooth long and straight, usually 2-celled, second tooth small, single-celled; presence of intermediate nodular thickenings in median cells	*Cololejeunea manilalia*

Cololejeunea manilalia Manju, Chandini et Rajesh, *spec. nova*
(Figs 1–2)

Type: INDIA, Kerala, Malappuram district, Nilambur, New Amarambalam Reserved Forest (bordering Mukurti National Park of Tamil Nadu), plants epiphyllous, seen in association with *Cololejeunea spinosa* and *Frullania* sp., 1,200 m alt., coll.: Rajesh, K. P. (111812a) 06.02.2010, (holotype: ZGC!; isotypes: BM!, CAL!, CALI!, ZGC!).

Diagnosis: Plants light yellowish green, yellowish brown in herbarium, main stem 3–6 mm long, about 0.04 mm in diameter, with leaves 0.4–0.45 mm wide; rhizoids few, hyaline, in tufts 8–9.7 μm wide; branching irregular, cross section of stem 42.3–57.2 μm across the diameter, with a circle of 5 cortical cells, 13.3–22 × 11.17–16.52 μm and one medullary cell, 12.75 × 9.46 μm, cells thin walled, trigones absent; leaves reniform in shape, distant, dorsal lobe mar-

gin convex, 0.18–0.23 mm long, 0.09–0.14 mm wide, margin densely spinose throughout, apex obtuse, ventral margin incurved at middle, marginal cells pentagonal in shape, 10–14.9 μm long, median cells 12.2–16.41 × 9.9–10.7 μm, pentagonal to hexagonal in shape, intermediate nodular thickening present, basal cells elongate, 22.2–28.6 μm, cells arranged at the base of leaf resembles the ocelli in size, one single dorsal papilla on each cell, leaf lobule 2/5–1/2 length of the leaf lobe, ovate, slightly inflated along the keel, stylus absent,

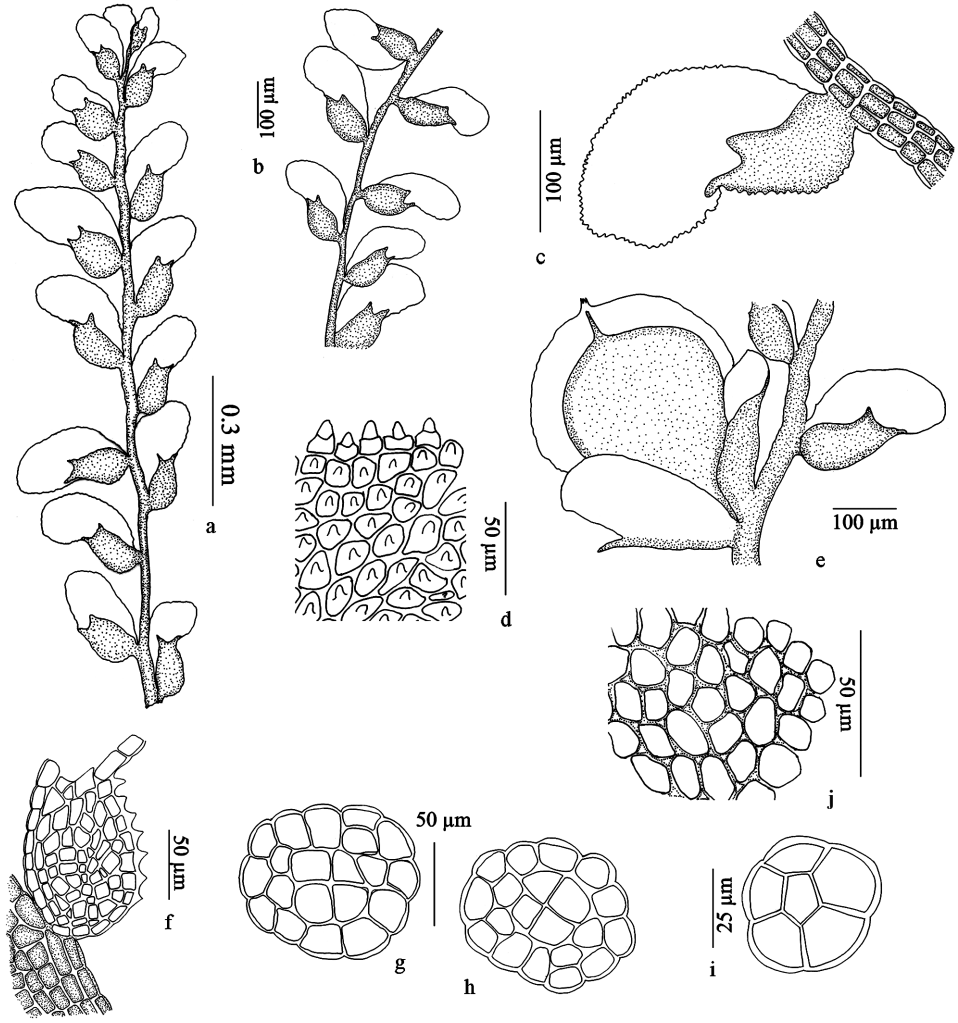

Fig. 1. Cololejeunea manilaliana. a–b = habit ventral view; c = leaf lobe with lobule; d = leaf marginal cells; e = gynoecial branch; f = cells of leaf lobule; g–h = gemmae; i = cross section of stem; j = leaf middle cells

Table 1
Comparison of the present species with *C. indica*, *C. nilgiriensis* and *C. spinosa*

	C. manilalia	*C. indica* (Singh and Pócs 2016)	*C. nilgiriensis* (Asthana and Srivastava 2003)	*C. spinosa* (Mizutani 1961, 1986)
Habitat	epiphyllous	epiphyllous	corticolous	epiphyllous, corticolous and rupicolous
Shoot length	3–6 mm	3–5 mm	3 mm	3–5 mm
Shoot width	0.4–0.5 mm	0.4–0.9 mm	0.04–0.06 mm	0.03–0.07 mm
Stem c.s.	42.3–57.2 μm diagonally, with 5 cortical cells, 13.3–22 × 11.17–16.52 μm and one medullary cell, 12.75 × 9.46 μm	50–55 μm across the diameter with five cortical cells 12.5–17.5 × 10–15 μm and one medullary cell 12.5 × 15 μm	five cortical cells 15–20 × 5–17 μm and one medullary cell, 11–14 × 6–9 μm	five cortical cells 11–25 × 4–21 μm and one medullary cell, 15 × 11 μm
Branching	irregular	irregular, *Lejeunea* type	rare	irregular
Leaves arrangement	distantly arranged	contiguous-imbricate	leaves distant, obliquely spreading	leaves imbricate
Leaf lobe shape	reniform, apex obtuse, ventral margin incurved at middle	ovate-oblong, apex sub acute	ovate, apex rounded	convex-ovate with pointed apex
Spines	spinose	spinose	spinose	spinose
Leaf lobe length	0.18–0.2 mm	0.30–0.42 mm	0.21–0.036 mm	0.27–0.54 mm
Leaf lobe width	0.09–0.14 mm	0.18–0.28 mm	0.12–0.18 mm	0.14–0.36 mm
Size and shape of marginal cells	pentagonal, 10–14.9 μm	quadrate-subquadrate or polygonal, 7.5–17.5 × 7.5–12.5 μm	small, rectangular, 8–16 × 4–12 μm	rectangular-polygonal, 12–49 × 8–25 μm with trigones
Size and shape of median cells	hexagonal to polygonal 12.5–16.4 × 9.9–10.7 μm, intermediate nodular thickenings present	pentagonal to hexagonal, 10–30 × 10–22.5 μm	polygonal 20–29 × 12–21 μm, intermediate nodular thickenings absent	15–25 × 12–15 μm, intermediate thickenings absent

Table 1 (continued)

	C. manilalia	*C. indica* (Singh and Pócs 2016)	*C. nilgiriensis* (Asthana and Srivastava 2003)	*C. spinosa* (Mizutani 1961, 1986)
Size and shape of basal cells	large, hexagonal, 22.2–28.6 μm	large hexagonal, 17.5–35 × 12.5–22.5 μm	basal cells elongated, 32–41 × 12–16 μm	elongated 40 × 15 μm
Vitta	not prominent, but vitta like cells are present	present, 4-celled	not present, but the cells from base up to lobule cells are elongated similar to present collection	absent
Vitta cell size	22.26–34.2 × 4.1–8.71 μm	37.5–50 × 15–22.5 μm	–	–
Leaf lobule	ovate, slightly inflated along the keel, bilobed, first tooth long and straight usually 2-celled, the second tooth is small, ventral side spinose due to projecting cells, 0.08–0.14 mm × 0.06–0.09 mm	leaf lobule inflated, 2 toothed, first tooth 1–2-celled second tooth small, single-celled often indistinct 0.08–0.12 × 0.05–0.09 mm, keel broad inflated spinose dentate	leaf lobule inflated bilobed, first tooth small, single-celled second tooth also single-celled, keel broad inflated sharply crenulated	ovate inflated along the keel bidentate hyaline papilla at proximal base of 2-celled first tooth, second tooth small single-celled 2/5–1/2 the length of lobe cernulate to spinose
Stylus	stylus absent	stylus present	stylus absent	stylus minute
Gynoecium	gynoecium on short lateral branches	gynoecium on short lateral branch, with subgynoecial innovation	gynoecium with one subgynoecial innovation	terminal or less elongated branches
Bract	bract one pair, spinose, 0.21–0.28 mm	bract in one pair almost similar to leaf lobe	0.28–0.35 × 0.08–0.14 mm	–
Perianth	perianth spinose, 0.32–0.36 mm long	perianth pyriform, 0.25–0.30 mm	perianth not seen	perianth spinose
Gemmae	present, disciform, 20-celled	present, disciform, 16-celled	present, discoid, 20 celled	very rare, if present discoid, 16-celled

bilobed, first tooth long and straight usually 2-celled, second tooth small, ventral side spinose due to projecting cells; keel arched, densely spinose; gynoecium on short lateral branches, bract one pair, spinose, compared to normal leaf lobe bract linear, 0.21–0.28 mm, perianth spinose, 0.32–0.36 mm long, androecium not observed; discoid shape, with 20 cells (Figs 1–2).

Ecology: Plants epiphyllous, seen in association with *C. spinosa* and *Frullania* sp.

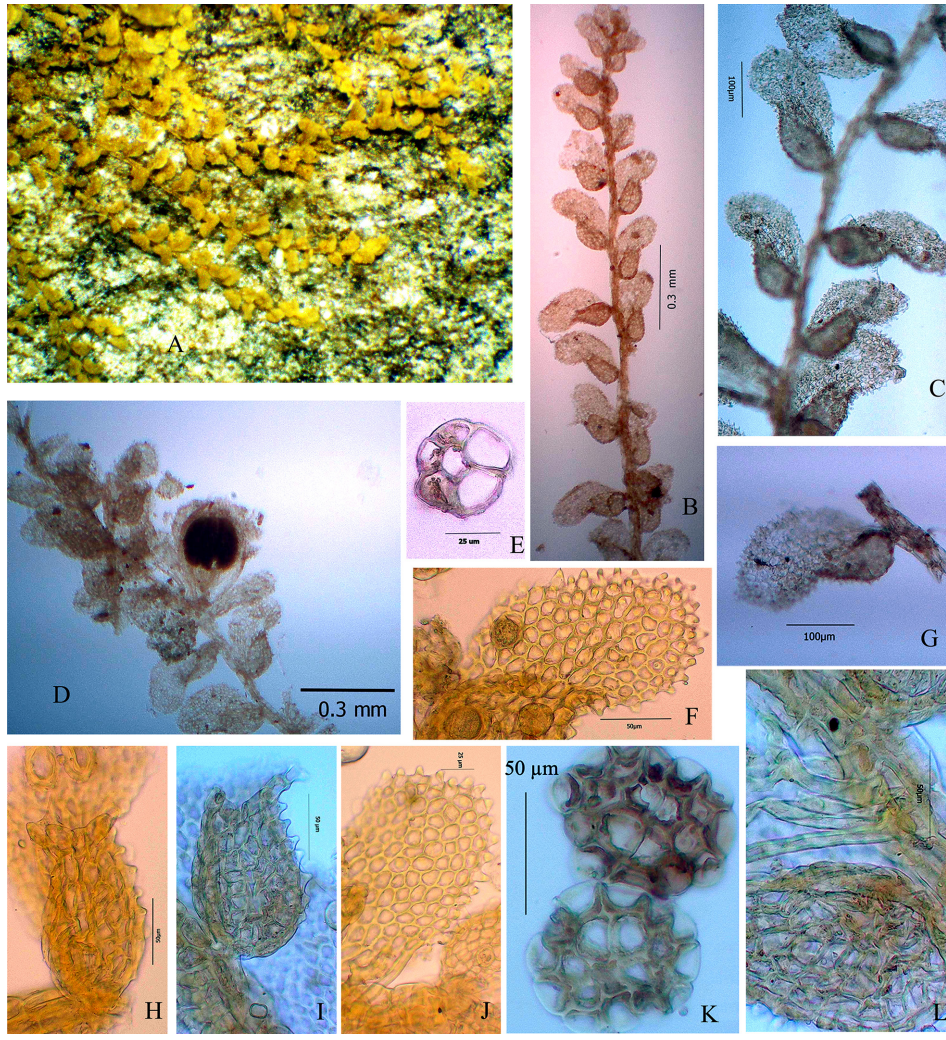

Fig. 2. Cololejeunea manilaliana. A = habit; B–C = branch; D = branch with gynoecium; E = cross section of stem; F, J = leaf lobe; G = leaf lobe with lobule; H–I = lobule; K = gemmae; L = rhizoids arising from stem

Other specimens examined: INDIA, Kerala, Malappuram district, New Amarambalam Reserved Forest (1,250 m), coll.: Rajesh, K. P. (111812 a, 111820, 111825), 06.02.2010, (ZGC!).

Taxonomic notes: *Cololejeunea manilalia* sp. nov. shows similarities with *C. indica* Pande et R. N. Misra in plant size, irregular branching, presence of prominent spines, size of basal cells which is similar to vitta and lobule characters, especially bilobed nature with 2-celled first tooth and indistinct single-celled second tooth, gynoecium on short lateral branches having one pair of bract. But the present species can be distinguished from *C. indica* Pande et R. N. Misra in its distantly arranged leaves, reniform shape of leaf, absence of stylus, size of cells in marginal and median portion, presence of nodular thickenings in median cells, absence of prominent vitta and number of cells in gemmae. *C. manilalia* sp. nov. is closely related to *C. nilgiriensis* G. Asthana et C. Srivast. in leaf arrangements and appearance of the plant, presence of spines on the leaves, absence of stylus, leaf incurved at middle, 20-celled gemmae and absence of vitta. But the present species differs from *C. nilgiriensis* G. Asthana et C. Srivast. in the size of the plant, reniform shaped leaf, irregular branching, size of the leaf cells, presence of intermediate nodular thickenings in median cells, bilobed lobule, first tooth long and straight usually 2-celled, small second tooth, ventral side spinose due to projecting cells. Present collection also related with *C. spinosa* (Horik.) Pande in size of plant, irregular branching, presence of prominent spines and one single dorsal papilla on each cell with bilobed lobule. *C. manilalia* sp. nov. differs from *C. spinosa* (Horik.) Pande by distantly arranged leaves, reniform shape and size of the leaf, absence of stylus, cell size, presence of nodular thickenings in median cells, absence of hyaline papilla on the inner surface of lobule at the first tooth and the gynoecium on short lateral branches.

Even though the present species shows similarities with *C. indica* Pande et R. N. Misra, *C. nilgiriensis* G. Asthana et C. Srivast. and *C. spinosa* (Horik.) Pande; it has its own characters such as arrangement of leaf on the stem, reniform shape of the leaf, absence of prominent vitta, absence of stylus and intermediate nodular thickenings in the median cells (Table 1).

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