

NOTES ON *COLURA CRENULATA* (LEJEUNEACEAE, MARCHANTIOPHYTA), A NEW RECORD FOR THAILAND, WITH A SPOROPHYTE DESCRIPTION

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Abstract. *Colura crenulata* Grolle (Lejeuneaceae), a rare and poorly known species from Papua New Guinea, Sumatra and Borneo, was newly discovered in tropical montane forests in southern Thailand. It is characterized by its acutely mamilliose lobule sac and perianth; apical crest of the lobule sac consisting of 1–5 cells; large valve composed of 18–21 hyaline margin cells and 20–29 median cells, with a single median basal cell; and nearly entire dorsal margin of the leaf. This species is described and illustrated in detail, and its diagnostic characters and a comparison with the related species are briefly treated.

Key words: *Colura*, diversity, elater pattern, liverwort, Thailand

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INTRODUCTION

The genus *Colura* was proposed as a section of *Jungermannia* L. (Dumortier 1831) and was subsequently raised to generic rank by Dumortier (1835) based on *C. calyptrifolia* (Hook.) Dumort. This genus belongs to Lejeuneaceae, which is the largest family of the liverworts (Gradstein 2013) and contains ca 83 currently accepted species (Söderström *et al.* 2016), of which 39 are endemic (Pócs 1996; Frey & Stech 2009). Most species of the genus are small and epiphyllous in habit, but some species occur on tree trunks and branches. The genus *Colura* is easily separated from other genera by (i) having one deeply bilobed underleaf for each lateral leaf, (ii) the presence of tubular to cylindrical leaf lobules usually broadening distally and terminating in a sac, and (iii) the presence of a valve and pore in the sac. The genus is distributed mainly in tropical and subtropical regions (Pócs 1996; Zhu & So 2001; Frey & Stech 2009), with a hotspot in the Malesian region (Pócs 1996). There are floristic reports of

Colura species from parts of the Malesian region, such as the Philippines and Borneo (Tan & Engel 1986), Java (Söderström *et al.* 2010), Malaysia (Kitagawa 1969; Chuah-Petiot 2011) and Thailand (Jovet-Ast 1967a; Lai *et al.* 2008; Sukkharak *et al.* 2008; Chantanaorrapint & Pócs 2014; Pócs & Podani 2015). However, some *Colura* species are rarely reported and have been collected only once or a few times.

During a revision of the genus *Colura* in the Malesian region, some interesting specimens were found at the summit of Khao Chedyod Mt. in southern Thailand. After a careful examination, the unknown collections were identified as *Colura crenulata* Grolle, a little-known species first described by Grolle (1965) based on a specimen collected by M. S. Clemens in Morobe Province, Papua New Guinea, and subsequently reported by Jovet-Ast (1967b) from Sumatra, Indonesia and Sabah, Malaysia. This is the third report of the species and the first one from Thailand. The following description and illustrations are based on the recent specimens from Thailand. In addition,

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the sporophytes of *Colura crenulata* are described in detail for the first time.

DESCRIPTION

Colura crenulata Grolle Figs 1 & 2
J. Hattori Bot. Lab. 28: 46. 1965

TYPE: PAPUA NEW GUINEA. MOROBE: Yunzaing, 1500–1800 m, 1936, *M.S. Clemens 3817/H-b* (HOLOTYPE: B).

Plants pale green, 0.3–1.0 cm long; shoots 1.2–2.5 mm wide; irregularly pinnately branched, branches *Lejeunea*-type. *Stem* 100–137 μm in diameter, in transverse section consisting of 7 cortical cells (37–63 \times 27–48 μm) and 3 medullary cells (25–38 \times 20–28 μm); ventral merophytes of stem 2 cells wide. *Rhizoids* numerous, fasciculate at base of underleaves. *Leaves* contiguous to imbricate, spreading from stem at 0°–70° angle. *Lobes* 0.75–1.45 mm long, 0.40–0.75 mm wide; dorsal margin \pm plane, entire to crenulate. *Lobe cells* thin-walled, trigones large, intermediate thickenings very distinct; marginal cells isodiametric to slightly rectangular or subquadrate, 25–45 \times 25–35 μm ; median cells rectangular, isodiametric to hexagonal, 32–63 \times 22–38 μm ; basal cells rectangular to hexagonal, 37–63 \times 20–45 μm . *Cuticle* smooth. *Oil bodies* 14–20 per cell, homogenous, ellipsoid, 4–8 \times 1.6–3.2 μm . *Lobules* narrowly tubular, flaring toward sac, 1.35–2.25 mm long. Lobule sac elliptic, strongly inflated, 0.6–1.9 mm long, 0.50–0.65 mm wide, sac surface conical-mamillose, apex acute, ending in lamellar crista consisting of 1–5 cells. *Valves* complex-type, elliptic, broadly ovate to slightly round, 114–144 \times 94–124 μm , composed of one circle of 18–21 hyaline marginal and 20–29 median cells with one basal median cell. *Hyaline papilla* spherical, 15–20 μm in diameter. *Valve frame* outline semicircular with cell triseriate, *ca* 182 μm wide; cell wall entire to slightly undulate. *Underleaves* distant, deeply bilobed, sinus obtuse; lobe lanceolate, 150–200 \times 55–115 μm , 6–7 cells long, 4–5 cells wide at base; margin entire.

Diocious. *Androecia* lateral or intermediate on main stem and branch; male bracts hemispherical,

apical keel crenulate with one projecting cell row, free margin entire, in 2–7 pairs; bract lobes oblong to semicircular, 230–300 \times 160–185 μm ; bract lobules semicircular, 220–290 \times 145–185 μm , bract lobules as large as bract lobes. *Antheridia* 2 per bract; male bracteoles bilobed to round, small, few-celled. *Gynoecia* terminal on lateral branch; female bracts ovate to elliptic; bract lobes oblong to elliptic, 750–900 \times 250–450 μm ; bract lobules narrowly oblong, 750–800 \times 150–200 μm ; female bracteole similar to underleaf, 125–250 \times 37–88 μm . *Perianth* obovate to obtriangular, 1.35–1.50 mm long, 0.45–0.75 mm wide, with 3 keels; keels oblique-triangular or horn-like, 250–300 \times 170–220 μm , spreading horizontally, bearing a coarse tooth near its apex; surface of perianth strongly mamilllose; beak 1–3 cells long. *Sporophyte*. *Seta* articulate, 8–9 cells long, upon elongation to 1.5–2.0 mm long. *Capsule* spherical, 325–360 μm in diameter, splitting \pm 2/3 its length into four erect valves after dehiscence; capsule valve 360–370 \times 230–240 μm , wall 2–3 stratose, hyaline. *Outer layer capsule valve* apex formed by one quadrate cell; cell of upper half of valve rhombic, large, thin-walled; hinge butterfly-shaped, hinge cells rectangular to quadrate, smaller than upper-half cells, thin-walled; marginal cells rectangular, formed by 1–2 rows. *Inner layer capsule valve* cells in center rectangular, walls with nodular thickenings; marginal cells of upper half quadrate, walls nodulose, formed by 1–2 rows, marginal cells of lower half rectangular, walls smooth. *Elaters* of two types: marginal and additional; marginal elaters 22 per capsule, each valve containing 4 or 5 upper marginal elaters and 2 or no lower marginal elaters; upper marginal elaters attached to upper half of valve margin by one end, 220–305 μm long, 16–20 μm wide, hyaline to yellowish, with irregular thickening, end attached to valve margin rounded, not expanded, free end dilated; lower marginal elaters attached to valve at both ends (near and parallel to basal margin), *ca* 200 μm long, 20 μm wide, hyaline, with irregular to annular thickening, upper end narrowly tapered, lower end obtuse; additional elaters 4 per capsule (1 per each valve), 280–310 μm long, *ca* 10 μm wide, hyaline, with smooth thickening,

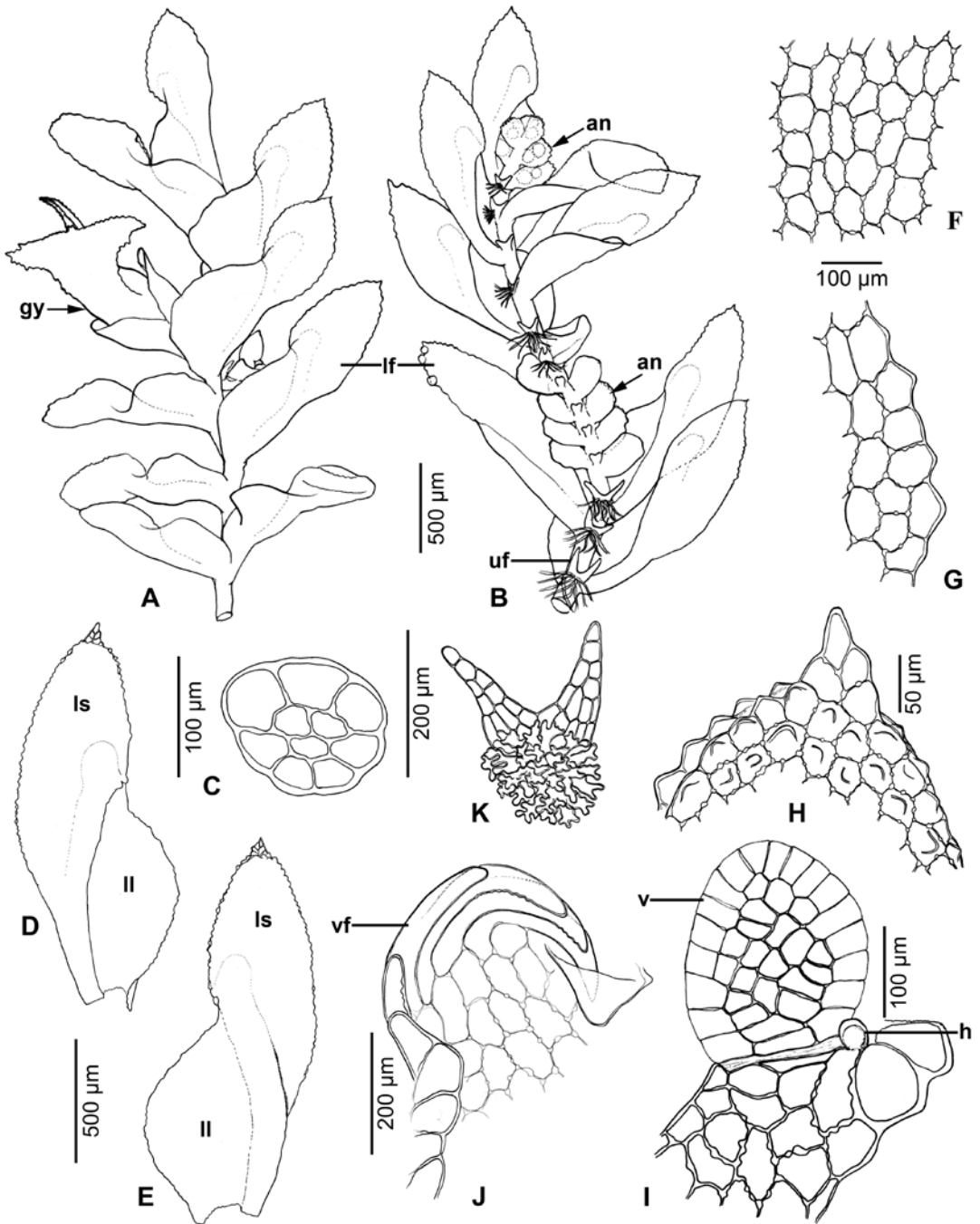


Fig. 1. *Colura crenulata* Grolle. A – portion of plant with gynoecium (gy), dorsal view; B – portion of plant with androecia (an), ventral view; C – stem in transverse section; D & E – lateral leaf (lf) consisting of leaf lobe (ll) and lobule sac (ls): D – ventral view, E – dorsal view; F & G – leaf lobe cells: F – median cells, G – marginal cells; H – crest and mamillae on apex of lobule sac; I – valve (v) and hyaline papilla (h); J – valve frame (vf); K – underleaf (uf). All from J. Sangrattanaprasert 138/14B (PSU).

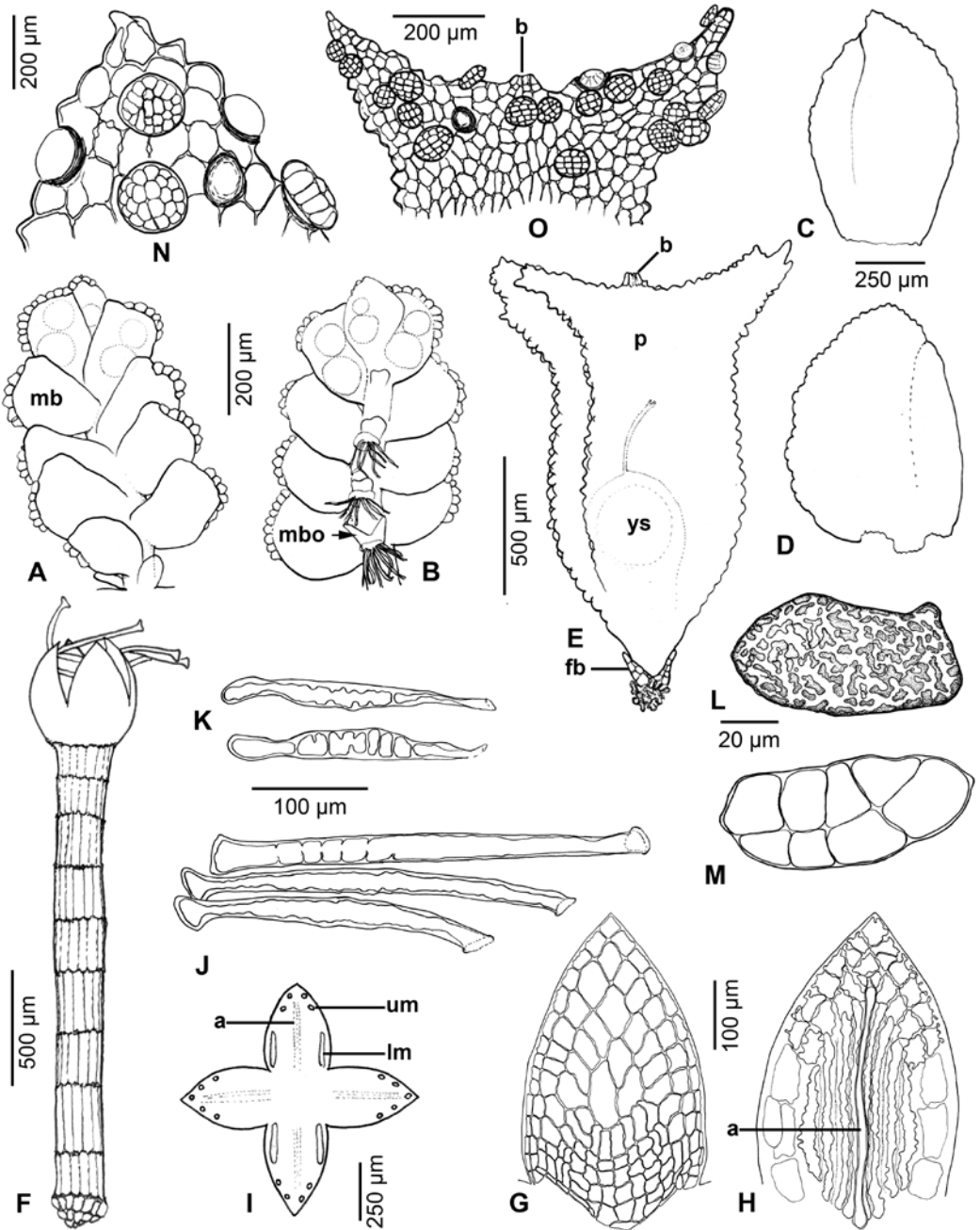


Fig. 2. *Colura crenulata*. A & B – androecia: A – dorsal view showing male bracts (mb), B – ventral view showing male bracteoles (mbo); C & D – female bract: C – dorsal view, D – ventral view; E – perianth (p) with female bracteole (fb) (b – beak of perianth, ys – young sporophyte); F – mature sporophyte; G – outer layer valve; H – inner layer valve; I – scheme of elater distribution (a – additional elater, lm – lower marginal elater, um – upper marginal elater); J – upper marginal elaters; K – lower marginal elaters; L – spore; M – spore showing cylindrical protonema; N & O – gemmae: N – occurring on lobule sac apex, O – occurring on perianth keel apex. All from *J. Sangrattanaprasert 138/14B* (PSU).

attached along their whole length to median part of valve, even upon dehiscence. *Spores* green, irregular-oblong or elongate-rectangular, 54–88 × 28–35 µm; spore surface covered with irregular lamellae; sporeling *Lejeunea*-type. *Asexual reproduction* by discoid gemmae, occurring on lobule sac apex and sometimes on perianth apex.

HABITAT AND ECOLOGY. *Colura crenulata* occurs on living leaves and twigs of shrubs and small trees in tropical montane forest at 1,000 to 1,100 m a.s.l. The species was associated with other epiphyllous liverworts such as *Ceratolejeunea belangeriana* (Gottsche) Steph., *Cheilolejeunea trapezia* (Nees) R. M. Schust. & Kachroo, *Drepanolejeunea* spp. and *Metalejeunea cucullata* (Reinw. et al.) Grolle.

DISTRIBUTION. Indonesia (West Sumatra), Malaysia (Sabah), New Guinea (Morobe), and new to Thailand.

SPECIMENS EXAMINED. INDONESIA. WEST SUMATRA: Mt. Tandikat, ca 1000 m, 23 July 1955, *W. Meijer 8077c* (L). MALAYSIA. NORTH BORNEO: Mt. Tambuyokon, c. 15 miles NE. of Kinabalu Peak, 1800–2100 m, 6 July 1961, *W. Meijer B 11210* (L). THAILAND. TRANG PROVINCE: Palian District, Khao Chedyod, 1040–1070 m, 07°19'18.80"N, 99°54'40.48"E, 3 May 2014. *J. Sangrattanaprasert 115/14C, 138/14B, 140/14B* (HSNU, PSU).

TAXONOMIC NOTES. *Colura crenulata* is easily recognized by (i) the rather large plant, with leaves 0.6–1.1 mm wide, (ii) the large elliptic lobule sac, (iii) the strongly mamilliose surface of the lobule sac and perianth, (vi) the presence of the lamina projecting to the lobule sac apex, and (v) the entire dorsal margin of the leaf lobule.

Colura crenulata is morphologically similar to *C. thomeensis* Pócs, *C. herzogii* Jovet-Ast and *C. conica* (Sande Lac.) K. I. Goebel. The four species belong to subgenus *Colura*, section *Harmophyllum* Grolle, and share many similar characteristics in underleaf form, valve type, surface lobule sac and perianth, the presence of the apical crest of the lobule sac, and other characters. *Colura thomeensis*, an endemic species from Saõ Tomé Island (Pócs 2011), is distinguished from *C. crenulata* by its large apical crest of the lobule sac consisting of 7–15 cells, and a small valve

composed of 12–13 hyaline marginal cells and 6–8 median cells. *Colura conica*, a common species in tropical and subtropical Asia (Zhu & So 2001), is distinguished from *C. crenulata* by the dentate dorsal margin of leaf the lobes, the valve consisting 13–18 median cells (with 1–2 basal cells) and one circle of 14–17 hyaline marginal cells, and the perianth with (3–)4(–5) keels. *Colura herzogii*, a Malesian species (Jovet-Ast 1953), differs from *C. crenulata* in having 1–2 basal median cells of the valve and an irregularly dentate dorsal leaf margin. Pócs (2013) also noted that *C. crenulata* is quite similar to *Colura fastigiata* Jovet-Ast, an endemic species from Cambodia (Jovet-Ast 1958), but the latter differs from *C. crenulata* in having 2 basal median cells of the valve and a strongly dentate dorsal margin of the leaf lobe.

The sporophyte characters of *Colura crenulata* are similar to other members of the genus in having an articulate seta, dehiscence of a spherical capsule into four valves, and the elaters attached to the upper half margin of the inner side of the valve (Jovet-Ast 1953). We also studied the elaters of the following species: *C. herzogii*, *C. imperfecta* Steph., *C. karstenii* K. I. Goebel, *C. meijeri* Jovet-Ast, *C. speciosa* Jovet-Ast and *C. verdoornii* Herzog & Jovet-Ast. The two types of elaters are similar within the eight species: 22 marginal elaters (18 upper and 4 lower), plus additional elaters. The additional elaters might be confused with the median cells of the inner wall of the valve, which is somewhat elongated-rectangular with nodular thickenings. For a better understanding of the elater pattern of the genus, more species need to be investigated.

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