

## The genus *Calycularia* (Calyculariaceae, Marchantiophyta) in Thailand

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### ABSTRACT

A taxonomic study of the genus *Calycularia* in Thailand is presented, based on herbarium specimens and field surveys. Only one species is recognized in the country, namely *Calycularia crispula*. A detailed description, line drawings and photographs are provided. In addition, *Apopellia endiviifolia* (Pelliaceae) is excluded from the Thai bryoflora.

KEYWORDS: *Apopellia endiviifolia*, bryophyte, *Calycularia crispula*, Calyculariaceae, Thailand, thalloid liverwort.

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### INTRODUCTION

*Calycularia* Mitt. is a small genus of simple thalloid liverworts recently placed in the monotypic family Calyculariaceae (Crandal-Stotler *et al.*, 2008). The genus contains only two species: *Calycularia crispula* Mitt. and *C. laxa* Lindb. & Arnell (Konstantinova & Mamontov, 2010; Söderström *et al.*, 2016), widely distributed from North America and northern Russia to tropical East Africa and tropical Asia. *Calycularia* is easily separated from most simple thalloid liverworts by the presence of ventral scales (Konstantinova & Mamontov, 2010).

There are few published reports of *Calycularia* in Thailand, perhaps due to the scarcity of bryological surveys in the past (Sukkharak & Chantanaorrapint, 2014), but one of the two species, *C. crispula*, has been reported from Doi Inthanon and Doi Pha Hom Pok National Parks, Chiang Mai Province (Kitagawa, 1969; Lai *et al.*, 2008; Konstantinova & Mamontov, 2010). The purpose of this paper is to summarize the current knowledge of the genus *Calycularia* in Thailand and to provide a detailed description of *C. crispula*.

### MATERIAL AND METHODS

This study was based on fresh specimens collected in northern Thailand as well as herbarium specimens housed in BCU, BKF, CMUB, MO and PSU. Morphological and anatomical details were studied using stereo, compound and electron microscopes and the distinctive characters of *Calycularia crispula* were illustrated with the aid of an Olympus drawing tube. All cited specimens have been seen by the authors.

### TAXONOMIC TREATMENT

***Calycularia crispula*** Mitt., J. Proc. Linn. Soc., Bot. 5: 122. 1861. Type: India, Himalaya, Sikkim, *J.D. Hooker 1679* (lectotype **LE**, designated by Konstantinova & Mamontov (2010); isolectotypes H-SOL, **P** [PC0101872, PC0101873] photos seen). Figs. 1–2.

— *Pellia endiviifolia* auct. non (Dicks.) Dumort.: Lai *et al.*, Ann. Bot. Fenn. 45: 330. 2008.

Thalli yellowish-green to dark green, margins strongly undulate or crispate, 5–10 cm long, 0.5–0.8 cm wide; branches lateral, irregular or furcate; apical

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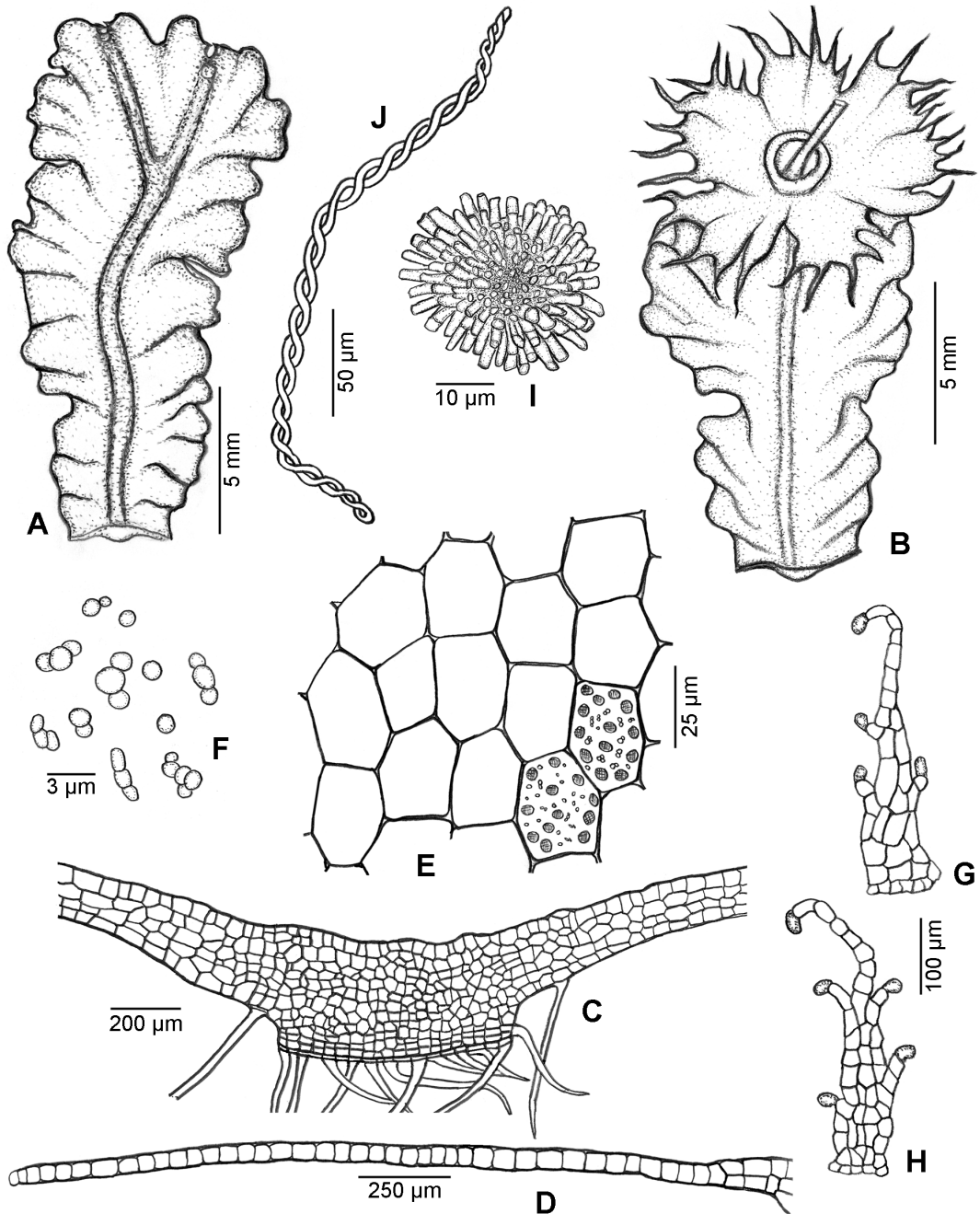


Figure 1. *Calycularia crispula* Mitt.: A. Sterile thallus, dorsal view. B. Female thallus with pseudoperianth, dorsal view. C–D. Transverse section of thalli, C. median part, D. marginal part. E. Dorsal epidermal cells of thallus with chloroplasts (black) and oil-bodies (light). F. Oil bodies. G–H. Female scales. I. Spore. J. Elater. All from *Printarakul 5010* (CMUB). Drawn by N. Printarakul.

portion of thallus emarginated or nearly obcordate; costa distinct, rather broad, 1–1.8 mm wide, more-or-less flat dorsally and convex ventrally, in transverse section up to 15–20 cells thick, gradually tapering into unistratose lamina, dorsal epidermal cells rectangular to rectangular-hexagonal,  $30\text{--}80 \times 25\text{--}50 \mu\text{m}$ , central strand lacking; unistratose lamina 40–50 cells wide. *Ventral scales* in 2 rows on costa, visible

near the apical notch, hyaline, purplish or purplish-red, linear to lanceolate,  $300\text{--}1500 \times 80\text{--}250 \mu\text{m}$ , straight or recurved, 2–5(–6) cells wide at the base, gradually or abruptly tapering to a long uniseriate tip, with marginal cilia or slime papillae. *Oil-bodies* minute, of 2–5 granules, 20–50 per cell. *Rhizoids* yellowish, pale brown or colorless, numerous, restricted to ventral side of costa.

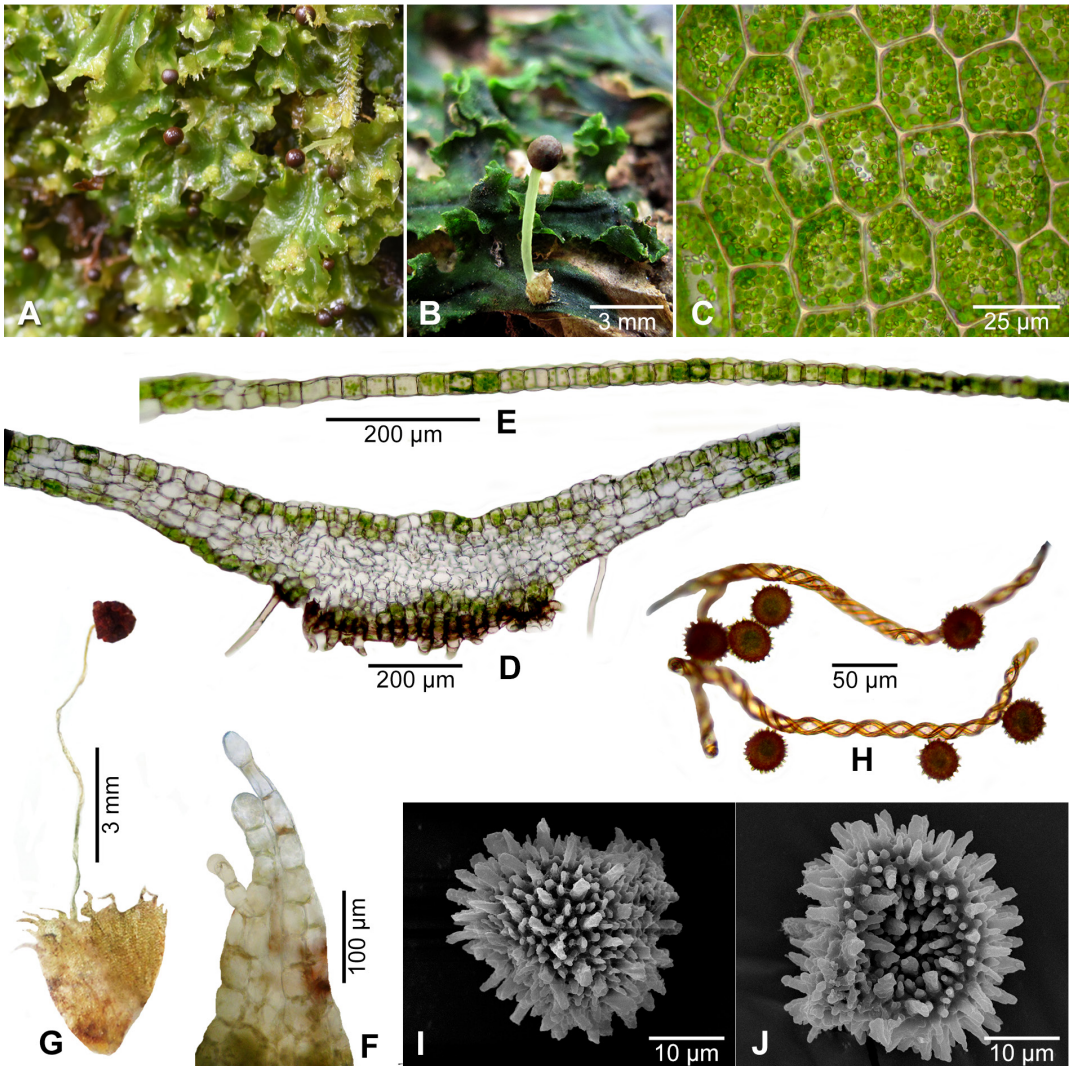


Figure 2. *Calycularia crispula* Mitt.: A–B. Plants with sporophytes, A. moist condition, B. dry condition. C. Dorsal epidermal cells of thallus. D–E. Transverse section of thalli, D. median part, E. marginal part. F. ventral scale. G. Pseudoperianth and sporophyte. H. Spores and elaters. I–J. SEM images of spores showing their variation, I. subtriangular, J. globose. All from *Printarakul 5010* (CMUB). Photographed by N. Printarakul.

Dioicous. *Antheridia* dorsal, in several rows along costa, covered by perigonial scales, 1–4 sessile, globose antheridia per scale; scales unistratose, pale green or colourless, erect, lamelliform, lacinate-dentate at the apex. *Archegonia* dorsal on costa, in dense clusters, surrounded by perichaetial scales; scales prostrate, colourless, lanceolate. *Pseudoperianth* colorless, campanulate to inflated-cylindrical, 3–4 cells thick at the base, unistratose at the apex; mouth with 3–4 lacinate lobes, with laciniae biseriate (or multiseriate) almost to the apex. *Capsule* brownish to blackish, globose, 1–1.2 mm in diam., dehiscing by 4–7 irregular valves. *Seta* up to 3 cm long, 7–10 cells in diam. *Spores* blackish to dark brown, subtriangular to globose, 30–45 µm in diam., the wall tuberculate; tubercles cylindrical, 4–7 µm long, truncate at the apex. *Elaters* brown, unbranched, 250–350 µm long, with 2–3-helicoidal bands.

Thailand.—NORTHERN: Chiang Mai [Doi Pha Hom Pok National Park, ca 2,000 m alt., 2 Nov. 2015, *Chantanaorrapint* 2949 (PSU)]; Doi Inthanon National Park, 19 Dec. 1965, *Touw* 9882 (MO, [MO-2201196]); Ang-ka, ca 2,500 m alt., 31 Dec. 1972, *Patanapolpaibun s.n.* (BCU); 14 Dec. 1978, *Thaithong* 902, 919 (BCU); 30 Nov. 2007, *Nati* 975 (BCU); 29 June 2008, *Nati* 1346 (BCU); 15 July 2012, *Chantanaorrapint* & *Promma* 1418 (BKF, PSU); 31 Oct. 2015, *Chantanaorrapint* 2867, 2874 (BKF, PSU); Kew Mae Pan natural trail, ca 2,300 m alt., 1 Nov. 2015, *Chantanaorrapint* 2829 (BKF, PSU); Doi Chiang Dao Wildlife Sanctuary, Huai Tat, ca 1,000 m alt., 11 Dec. 1978, *Thaithong* 463 (BCU); Pang Eiak, 1,200 m alt., 11 Dec. 1978, *Thaithong* 716 (BCU); Doi Suthep-Pui National Park, Doi Mon Long Mt, ca 1,340 m alt., 4 Aug. 2005, *Monlong* 59 (CMUB); Doi Pui Mt, ca 1,600 m alt., 16 Nov. 2010, *Printarakul* 5010 (CMUB)]; Phitsanulok [Phu Hin Longkla National Park, Lan Hin Pum, ca 1,300 m alt., 28 May 2018, *Chantanaorrapint* & *Suwanmala* 2653 (BKF, PSU)].

Distribution.—Widespread, but scattered, from East Africa to Asia and the Indian subcontinent, including Ethiopia, Malawi, Tanzania, Zambia, Bhutan, China, India, Myanmar, Nepal, Taiwan, and Thailand (Kitagawa, 1969; Lai *et al.*, 2008; Konstantinova & Mamontov, 2010; Daniels *et al.*, 2014; Manju *et al.*, 2015). Also reported from Costa Rica (Dauphin, 2005) and Mexico (Grolle, 1980) but these reports are based on single collections and are likely dubious (B. Crandall-Stotler, pers. comm).

Ecology.—In Thailand, *Calycularia crispula* grows on the bases of tree trunks, decaying wood and humus rich rocks in humid montane forests at 1,200–2,550 m. It is usually associated with other liverwort species of the genera *Bazzania* Gray and *Plagiochila* (Dumort.) Dumort.

Notes.—*Calycularia crispula* is characterized by 1) strongly undulate or crispate thallus margins forming lobe-like structures, 2) costa clearly distinct from the unistratose wings, 3) mouth of pseudoperianth lacinate with lacinia biseriate to multiseriate almost to the apex, and 4) spores that are densely tuberculate with the tubercles cylindrical and apically truncate. In contrast, *Calycularia laxa* differs from *C. crispula* by its pseudoperianth mouth being ciliate, with cilia uniseriate almost from the base and spore ornamentation being echinate or spinose.

In their general appearance, *Calycularia* is similar to *Pellia* Raddi but *Calycularia* has ventral scales along the costa whereas *Pellia* does not. *Calycularia* may also be confused with *Pallavicinia* Gray, which also possesses a distinct costa, unistratose thallus wings and gametangia along the costa. However, *Pallavicinia* differs from *Calycularia* in having ventral hairs rather than scales, and having a central strand in the costa.

Lai *et al.* (2008) reported *Apopellia endiviifolia* (Dicks.) Nebel & D. Quandt (as *Pellia endiviifolia* (Dicks.) Dumort.) for Thailand based on *Monlong* 59 (CMUB) from Doi Suthep-Pui National Park, Chiang Mai province. Re-examination of this specimen has revealed it to be *Calycularia crispula* and, consequently, *Apopellia endiviifolia* must be excluded for the Thai bryoflora.

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