Two Species of *Colura* (Family Lejeuneaceae) Newly Recorded to Taiwan

臺灣產管葉蘚屬(細鱗蘚科)兩個新紀錄種

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Abstract

There are three species of the genus *Colura* (Lejeuneaceae), *C. acroloba*, *C. inuii* and *C. tenuicornis*, previously reported from Taiwan. This paper describes two newly recorded species, namely *C. calyptrifolia* and *C. conica*. Their illustrations, habitat, and distribution are provided, plus a key to the species of *Colura* in Taiwan, for the identification.

摘 要

管葉蘚屬隸屬於細鱗蘚科，臺灣本屬原記載有刀形管葉蘚、印氏管葉蘚及細角管葉蘚等 3 種。本文報導 2 個新紀錄種，僧帽管葉蘚(新擬中名)及尖囊管葉蘚，文中附有此 2 種新紀錄種之形態描述、圖片及棲地與分布等資料，以及臺灣產本屬物種之檢索表。

keywords : *Colura, C. calyptrifolia, C. conica,* liverwort, Taiwan

關鍵詞：管葉蘚屬、僧帽管葉蘚、尖囊管葉蘚、蘚類、臺灣

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Introduction

Colura is a large pantropical genus of Lejeuneaceae, consisting of about 70 species (Gradstein and Costa 2003). *Colura* is easily distinguished from other genera of Lejeuneaceae by having (1) epiphyte or epiphyllous, (2) lateral leaf with a strongly diverging bifid underleaf, (3) leaf lobes with variously saccate upper part and the sac with a pore and valve, and (4) cylindrical and inflated leaf lobule with involute free margin, usually connate with the leaf-lobe (Yang 2009).

Three species of the genus *Colura* have been reported from Taiwan. There are *C. acroloba* (Mont. ex Steph.) Ast, *C. inuii* Horik. and *C. tenuicornis* (A.Evans) Steph. (Piippo 1990, Lin 2000, Zhu and So 2001, Yang 2009, Wang *et al.* 2011). In our recent plant inventory survey of Taiwan, we found *C. calyptrifolia* (Hook.) Dumort**.** and *C. conica* (Sande Lac.) K.I.Goebel, as two new records to the liverwort flora of Taiwan. This paper briefly describes them with illustrations and information on habitats and geographical distributions. A key to the species of *Colura* in Taiwan is also provided for identification. The voucher specimens are deposited at the Herbarium of Endemic Species Research Institute (**TAIE**), the Herbarium of Tunghai University (**TUNG**), and the Herbarium of Eszterházy College (**EGR**).

Taxonomic Treatment

Colura (Dumort.) Dumort. 管葉蘚屬

Recueil Observ. Jungerm. :12. 1835. Type: *Colura calyptrifolia* (Hook.) Dumort. (≡ *Jungermannia calyptrifolia* Hook.)

Keys to the species of *Colura* of Taiwan

1. Cells of leaf lobes without trigones and intermediate thickenings; sac with a narrow prolongation at the tip…….2
1. Cells of leaf lobes with distinct trigones and intermediate thickenings; sac ovate to triangular-ovate without a narrow prolongation at the tip.....3
2. Sac fusiform, prolongation shorter, separation between sac and prolongation sharp; keels of perianth short.....*C. calyptrifolia*
2. Sac lanceolate, prolongation strongly elongated, separation between sac and prolongation not sharp; keels of perianth elongated strongly…...

..... *C. tenuicornis*

3. Valve connecting with the leaf lobule without hinge cells; leaves entire at margin..... .....*C. acroloba*
3. Valve connecting with the leaf lobule with hinge cells; leaves nearly entire to slightly denticulate.....4
4. Sac usually acute at apex; valve composed of 13-17 median cells and a circle of 15-16 hyaline cells…….…….... *C. conica*
4. Sac usually rounded at apex; valve composed of 16-20 median cells and a circle of 17-19 hyaline cells…….……..……. *C. inuii*

Colura calyptrifolia (Hook.) Dumort**.,** Recueil Observ. Jungerm. :12. 1835.

僧帽管葉蘚 Figs. 1, 3a–c

Description:

Plants small and prostrate in small dense patches; pale to bright yellowish green in color, occasionally white. Stems up to 5 mm long and 66–97 μm in diameter, with leaves 0.74–1.30 mm wide, irregularly branched. Leaves contiguous, erect-spreading from the substratum, and narrowing toward the apical beak, about 0.3 mm wide and 1.2 mm long including lobular beak, free part of antical lobe convex with margin crossing stem, margins entire. Cells of leaf lobes thin-walled, without trigones and intermediate thickening; median cells 15–22 × 20–46 μm, and basal cells larger. Cuticle smooth. Oil-bodies 7–31 per cell, oblong to orbicular in shape, with minute granules and smooth surface. Leaf lobule about twice as long as lobe, strongly inflated forming a fusiform sac, with a narrow beak-like prolongation at the tip, free margin involute strongly; valve at the mouth of the sac, ovate to short-ligulate, composed of 13–15 median cells and a circle of 15–16 thin-walled, hyaline marginal cells, and connected with lobule by rectangular hinge cells. Underleaves distant, deeply bilobed; lobes triangulate to lanceolate, up to 280 μm long and 4–8 cells wide at base, margins entire. Perianth obovoid, about 1.3 mm long and 0.5 mm wide, with 5 erected or horizontal horn-like keels and very short beak.

Habitat:

In the British Isles, *C. calyptrifolia* is common in lowland and subalpine at elevations from near the sea-level to 610 m, and found more often on rocks than on trees and shrubs (Paton 1999), whereas, in Brazil it is distributed at high elevations of 2,350m to 2,400m in the Serra do Itatiaia and found on branches and twigs of shrubs (Gradstein and Costa 2003). Our examinations of five specimens reveal that this species is distributed at elevations from 2,170 m to 3,450 m, and all found on tree barks or twigs in American and African,. Apparently, *C. calyptrifolia* is an epiphyte, growing on twigs and bark of shrubs, in the tropical mountains at elevations above 2,000 m, while near the sea level in oceanic temperate regions. In Taiwan, *C. calyptrifolia* is an element of mid-elevation coniferous forests of the Central Mountain Range at elevations above 2,000 m , growing on dead twigs of *Yusania* and dead branches of conifer tree, mixed with *Cololejeunea magnilobula*

(Horik.) S.Hatt., *Lejeunea flava* (Sw.) Nees, *Frullania* sp., *Metzgeria* sp. and *Ulota crispa* (Hedw.) Brid.

Distributions:

Oceanic-temperate regions of Africa, Latin America, western Europe (Gradstein and Costa 2003), and Sikkim Himalaya (Pócs pers. comm.). Common in Atlantic Europe (Jovet-Ast 1954), new to E. Asia and Taiwan.

Specimens examined :

TAIWAN. **Ilan County:** Twin Brothers Lakes located on northern part of the Central Mountain Range, on dead twigs of the *Yushania niitakayamensis* (Hayata) Keng f., beside lakes, without any shade, mixed with *Cololejeunea magnilobula* (Horik.) S.Hatt., *Lejeunea flava* (Sw.) Nees and *Ulota crispa* (Hedw.) Brid., at 2,130 m in elevations, 121°28'26"E; 24°28'43" N, Oct. 20, 2011, *J. -D. Yang 7313* (**TAIE**, **TUNG**, **EGR**). **Hualien County:** Along ridge of southern part of the Central Mountain Range, accessed via trails from Tafenjianshan to Heishueitang, on the dead branches of conifer tree, growing with *Cololejeunea magnilobula* (Horik.) S.Hatt., *Frullania* sp. and *Metzgeria* sp., at 3,121 m in elevations, 121°01' 22" E; 23°26' 19" N, Aug. 12, 2011, *J. -D. Yang 6959* (**TAIE**).

Additional specimens examined:

DOMINICA. Prov. San José de Ocoa, Central Cordillera, road between San José de Ocoa and Valle Nuevo, moist slopes with shrubs and pine forest with *Blechnum* and Lycopodiaceae, in places with abundant tree ferns above La Nuez, at 2,170-2,200 m in elevations, on twigs of a bush, Apr. 3, 2007, *Schäfer-Verwimp* & *Verwimp 26686* (**EGR**). **VENEZUELA**. Mérida State, Sierra Nevada National Park, La Aguada station, lower edge of the moor, with *Espeletia schulzii*, *Ruilopezia atropurpurea*, *Chaetolepis lindeniana*, etc., on branches, at 3,340-3450 m in elevations, 71°05' W; 8°35' N, Feb. 5, 1997, *T. Pócs 9702/DF* (**EGR**). **TANZANIA**. Kilimanjaro Mountains, Marangu Route, subalpine *Erica arborea* forest around Mandara Hut, corticolous, on *Erica arborea*, at 2,820 m in elevation, May, 19, 22, 1989, *T. Pócs & S. Orban 89145/AD* (**EGR**). Mt. Meru, WSW slope, montane rainforest in the Engare Narok Gorge, near the bridge, on decaying Ericaceous twigs, at 2,350 m in elevation, Dec. 13, 1989, *T. Pócs 89265/C* (**EGR**). **UGANDA**. Mbale District, W approach of Mt. Elgon, along Sasa Trail, Aroung and above Sasa River Camp, bamboo (*Sinarundinaria alpina*) stand with patches of broadleaved *Hagenia-Rapanea-Ocotea-Afrocrania* forest, Undergrowth of *Mimulopsis alpina*, on half woody twigs of *Mimulopsis alpina*, at 2,900 m in elevation, 34°26-27'E; 1°10.3'N, Sep. 21 & 23, 1997, *K. A. Lye 23016 p. p.* (**EGR**).

C. tenuicornis (A.Evans) Steph.: **JAPAN**. Kyushu, Kagoshima-ken, Isl. Yakushima, between Arakawa Dam and Kosugi-dani, at 700 m in elevations, on leaves. Dec.7, 1979, coll. Z. Iwatsuki; det. M. Mizutani [Bryophyta Exsiccata Fasc. 3 (1981) Edited by Z. Iwatsuki & M. Mizutani] (**TUNG**).

Remarks:

Colura calyptrifolia can be distinguished from other *Colura* species of Taiwan based on characters of cells without trigones and intermediate thickenings, lobule strongly inflated forming a fusiform sac and with a narrow beak-like prolongation tip. It is most closely related to the widely distributed pantropical *C. tenuicornis* (A.Evans) Steph. *C. tenuicornis* differs from *C. calyptrifolia* by having a lanceolate sac like lobule; prolongation strongly elongated; separation not sharp between sac and prolongation; perianth with strongly elongated horn-like keels. In Taiwan, *C. tenuicornis* is usually epiphyllus and distributed in lowland, but *C. calyptrifolia* is an epiphyte and only distributed at high mountains. Horikawa (1934) reported *C. pseudocalyptrifolia* Horik. from Mt. Arisan (Shinboku-Numanodaira), Mt. Taiheizan (Toganoodani-Sukoishi-Mururoafu), and Mt. Chipon (Miharashi-Miyama-Kiriyama-Chiponsan) in Taiwan. The syntype of *C. pseudocalyptrifolia* is located at Mt. Taiheizan which is close to our collection of *C. calyptrifolia*. Hattori (1951) treated it as *C. calyptrifolia* var. *pseudocalyptrifolia* (Horik.) S.Hattori, a taxon with a range from Shikoku, Yakushima to Taiwan. He remarked that "*C. tenuicornis* seems to stand near this." Jovet-Ast (1954) considered *C. calyptrifolia* var. *pseudocalyptrifolia* as a synonym of *C. tenuicornis*. Futhermore, Mizutani (1961) stated that Japanese plants of *C. tenuicornis* are not typically developed as those in the tropical region, and thus approximating *C. calyptrifolia* in size. Accordingly, the plants are often diffcult to distinguish from the latter. After examining the specimen of *C. tenuicornis* from Yakushima, Japan, and the figure of *C. pseudocalyptrifolia* (Horikawa 1934, p. 290), we found that both species have longer sac elongation, slender underleaf-lobe, and elongated horn-like keels of perianth, well agreeing with *C. tenuicornis*, while different from *C. calyptrifolia*.

C. calyptrifolia is an oceanic-temperate species found in the continents of Africa, American and European (Gradstein *et al.* 1983). As it has been also found in Sikkim Himalaya of Asia, the finding of *C. calyptrifolia* in Taiwan reveals a disjunctive distribution. Nevertheless, the oil bodies in the leaf cells of *C. calyptrifolia* are usually homogeneous (Paton 1999), with an exception in Taiwan's collections, which display minute granular, a character occurring in *C. tenuicornis*.

Colura conica (Sande Lac.) K.I.Goebel, Ann. Jard. Bot. Buitenzorg 39: 3. 1928.

尖囊管葉蘚 Figs. 2, 3d, e

Description:

Plants small and prostrate, pale to yellowish green in color. Stems up to 12 mm long, 79–103 μm in diameter, with leaves 1.6–3.1 mm wide, irregularly branched. Leaves imbricate to contiguous, erect-spreading from the substratum, 0.8-1.0 mm long, 0.4-0.7 mm wide; dorsal margin plane, crenulate to serrate or serrulate. Cells of leaf lobes thin-walled, trigones large, intermediate thickenings very distinct; marginal cells quadrate to rectangular, 21–28 × 16–25 μm; median cells isodiametric to hexagonal, 25–46 ×

23–33 μm; basal cells similar to median cells and larger 49–60 × 21–34 μm. Cuticle smooth. Oil-bodies up to 35 per cell, oblong to orbicular, granular. Leaf lobules about one and a half as long as lobe, strongly inflated forming a triangular-ovate sac with acute or sometimes round to subacute apex; free lateral margin involute strongly; valve at the mouth of the sac, ovate to short-ligulate, composed of 13–17 median cells and a circle of 15–16 very thin-walled, hyaline marginal cells, and connected with lobule by narrow rectangular hinge cells. Underleaves distant, deeply bilobed, the lobes lanceolate, up to 340 μm long, 4–5 cells wide at base, margins entire. Fertile plants, sporophyte, and gemmae not seen.

Habitat:

Colura conica is epiphyllous. In Borneo it is distributed at lowland, in coastal marsh-forests, mangroves, hygrophilous forests, brooklet or river banks, and Dipterocarpaceous forests at elevations up to 200 m (Jovet-Ast 1954). In China it grows on the leaves of trees and shrubs in the monsoon forest of Hainan Island at elevations of 600–1,200 m (Zhu and So 2001). In Fiji Islands, it is found on living leaves from lowland rainforest to mountain rainforests at elevations up to 1,010 m (Pócs and Eggers 2007). In Taiwan, this species grows in humid hardwood forest at lowlands at elevations below 1,000 m, on the living leaves of ferns, mixed with epiphyllous Lejeuneaceae, e.g. *Leptolejeunea elliptica* (Lehm. & Lindenb.) Schiffn., *Cololejeunea ceratilobula* (Chen) R.M.Schust., *C. planissima* (Mitt.) Abeyw., *C. goebelii* (Gott. ex Schiffn.) Schiffn., *C. spinosa* (Horik.) S. Hatt.

Distribution:

Colura conica is widespread in the Indo-Malesian-Oceanian, with a range in Sri Lanka to Thailand, Vietnam, China (Hainan), the Philippines, Borneo, Papua New Guinea, Australia, New Caledonia, the Carolines, and Samoa (Zhu and So 2001; Pócs and Eggers 2007). It is new to Taiwan.

Specimens examined:

New Taipei City: Fushan reservoir, Ha-pen Trail, Nan-shi Stream watershed, near the 1.5 km trail marker, mixed hardwood forest, epiphyllous on leaves of fern Cyclosorus truncatus (Poir.) Farw., mixed with *Cololejeunea spinosa*, *C. goebelii*, *C. ceratilobula*, *C. longifolia*, *Leptolejeunea elliptica*, *Lejeunea anisophylla*, and *L. ulicina*, at 320 m in elevations, 121°31’25.0”E; 24°46’ 23.7”N, Sep. 14, 2007, *J.-D. Yang 4647f* (**TAIE**). Fushan reservoir, Ha-pen Trail, Nan-shi Stream watershed, near the 1 km trail marker, bamboo-hardwood mixed forest, epiphyllous on leaves of fern *Angiopteris lygodiifolia* Rosenst., mixed with *Cololejeunea ceratilobula*, *C. goebelii*, *C. spinosa*, *C. inflata*, *C. planissima*, *Leptolejeunea elliptica*, *Lejeunea exilis*, *Dipasiolejeunea cavifolia*, and *Radula* sp., at 510 m in elevations, 121°30’37”E; 24°46’41”N, Sep. 14, 2007, *J.-D. Yang 4,680m* (**TAIE**). **Hualien County:** Yuli, Chikeshan, near the Fute Temple, creek bank, mixed hardwood forest, epiphyllous, on leaves of fern *Woodwardia* sp., mixed with

Cololejeunea ceratilobula, *C. goebelii*, *C. planissima*, *Leptolejeunea elliptica*, and *Lejeunea anisophylla*, ca. at 850 m in elevations, 121°23'16.2"E; 23°23'15.3"N, Oct. 18, 2007, *J.-D. Yang 4738g* (**TAIE**).

Remarks:

Colura conica is characterized by its slightly denticulate leaves, cells with distinct trigones and intermediate thickenings; triangular-ovate sac with acute apex, and valve connected with lobule by narrow rectangular hinge cells. These characters are distinguishable from those of other species of *Colura* of Taiwan. *C. conica* is similar to *C. inuii* Horik., which is only distributed in Taiwan and Japan (Tanegashima and Ryukyu) (Furuki 2001; Zhu and So 2001). The latter differs in the sac rounded at apex and larger valves composed of 16-20 median cells and 17-19 hyaline cells.

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Literature Cited

Furuki, T. 2001. Hepaticopsida. pp. 298-299. *In*: Z. Iwatsuki (ed.). Mosses and liverworts of Japan. Heibonsha Ltd. Publishers, Tokyo, Japan. (In Japanese)

Gradstein, S. R. and D. P. Costa. 2003. The Hepaticae and Anthocerotae of Brazil. Memoirs of New York Botanical Garden 87: 135–137.

Gradstein, S. R., T. Pócs and J. Váňa. 1983. Disjunct Hepaticate in Tropical America and Africa. Acta Botanica Hungarica 29 (1–4): 127–171.

Hattori, S. 1951. Contributio ad Floram Hepaticarum Yakusimensem (5). Journal of the Hattori Botanical Laboratory 5: 43–68.

Hattori, S. 1952. Hepaticae of Shikoku and Kyushu, Southern Japan (2). Journal of the Hattori Botanical Laboratory 8: 21–45.

Horikawa, Y. 1934. Monographia Hepaticarum Australi-Japonicarum. Journal of Science of the Hiroshima University Series B, Div.2, 2: 101–325.

Jovet-Ast, S. 1954. Le genre Colura, Hépatiques, Lejeuneacées, Diplasiae. Revue Bryologique et Lichénologique 22(1953): 206–312.

Lin, S.-H. 2000. The liverwort flora of Taiwan. The Council of Agriculture, Taipei, Taiwan. (In Chinese)

Mizutani, M. 1961. A revision of Japanese Lejeuneaceae. Journal of the Hattori Botanical Laboratory 24: 115–302.

Paton, J. A. 1999. The liverwort flora of the British Istes. Harley Books, Colchester,

England.

Piippo, S. 1990. Annotated catalogue of Chinese Hepaticae and Anthocerotae. Journal of the Hattori Botanical Laboratory 68:1–192.

Pócs, T. and J. Eggers. 2007. Bryophytes from the Fiji Islands, II. An account of the Genus *Colura*, with a description of *C. vitiensis sp. nov*. Polish Botanical Journal 52(2): 81–92.

Wang, J., M.-J. Lai and R.-L. Zhu. 2011. Liverworts and Hornworts of Taiwan: an updated checklist and floristic accounts. Annales Botanici Fennici 48: 369–395.

Yang, J.-D. 2009. Liverworts and Hornworts of Taiwan I. Lejeuneaceae. Endemic Species Research Institute, Nantou, Taiwan.

Zhu, R.-L., and M.-L. So. 2001. Epiphyllous liverworts of China. Nova Hedwigia Beiheft 121: 1–418.

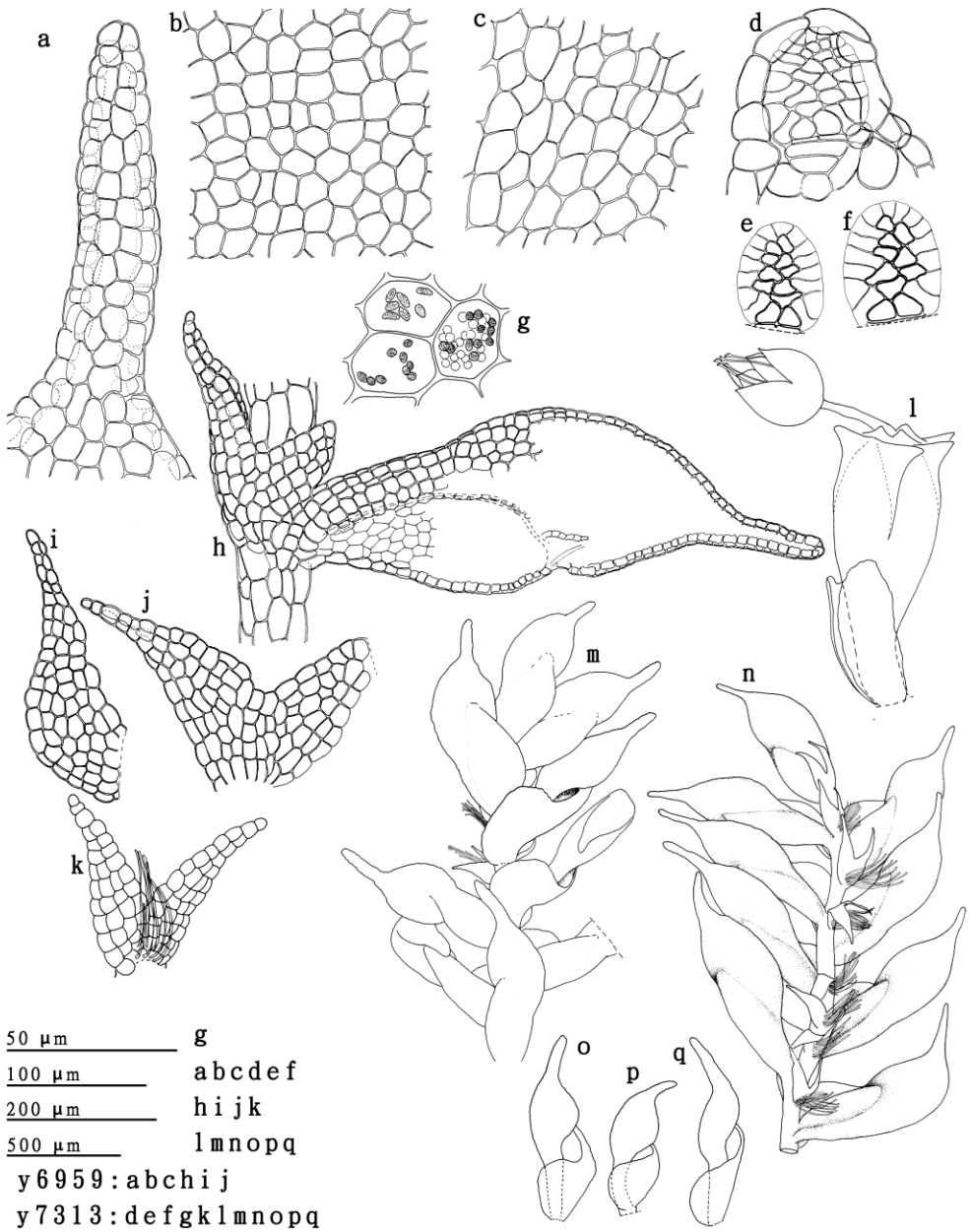

Fig. 1. ***Colura calyptrifolia*** (Hook.) Dumort.: a. beak-like prolongation at the leaf tip; b. median cells of leaf lobes; c. cells near the leaf base; d. valve at the mouth of the sac, connected with lobule by rectangular hinge cells; e, f. valves; g. oil bodies in the median cells of leaf lobe; h, n. ventral view of a portion of sterile plant; i–k. underleaves; l. perianth and sporophyte; m. dorsal view of a portion of sterile plant; o–q. leaves. Drawn from *J. -D. Yang 6959, 7313*.

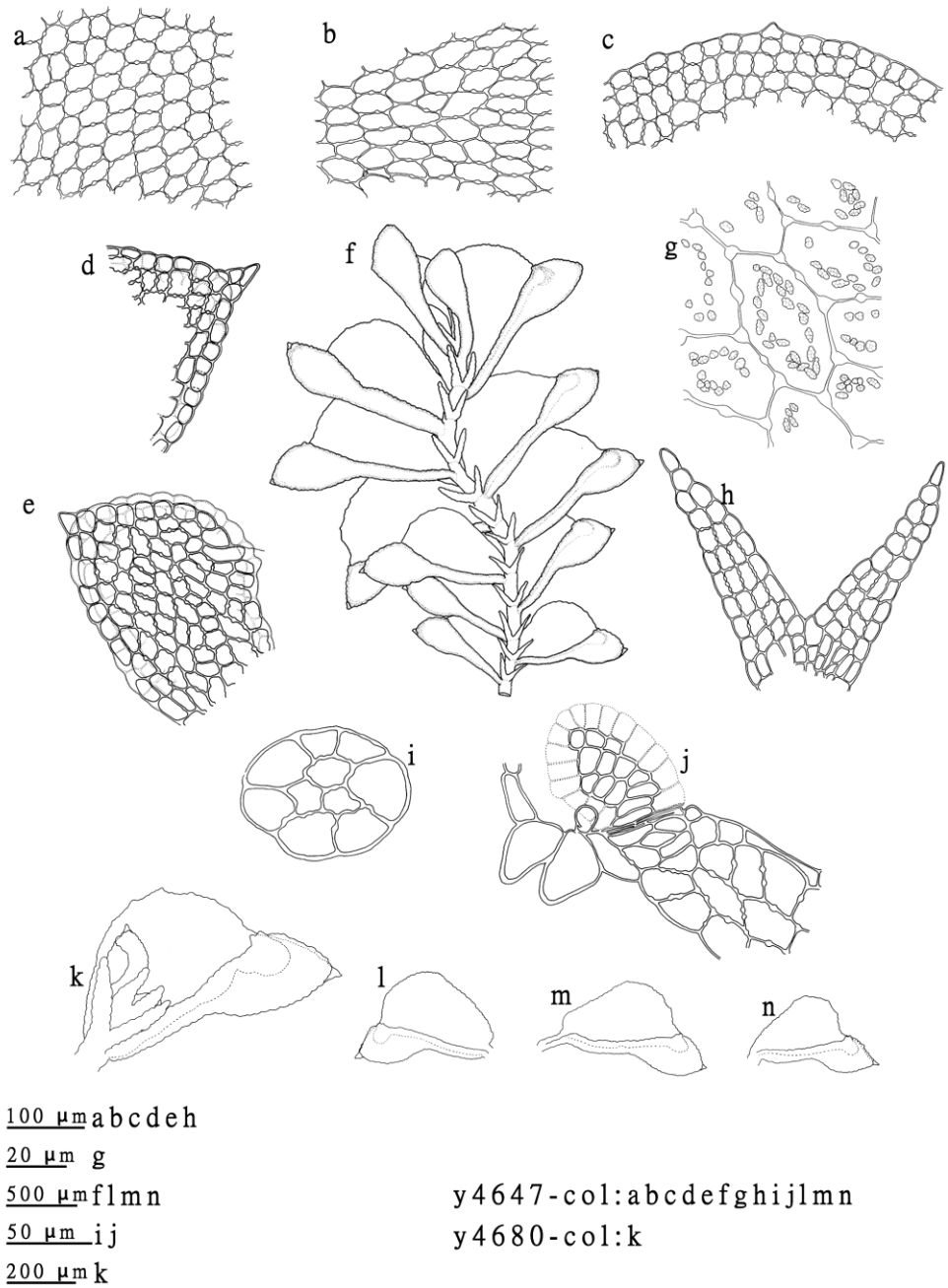

Fig. 2. ***Colura conica*** (Sande Lac.) K.I.Goebel: a. median cells of leaf lobes; b. basal cells of leaf lobe; c. marginal cells of leaf lobes; d, e. apex of lobule sacs; f. ventral view of a portion of sterile plant; g. oil bodies in the cells of leaf lobe; h. underleaf; i. transverse section of stem; j. valve; k–n. leaves. Drawn from *J. -D. Yang 4647f, 4,680m*.

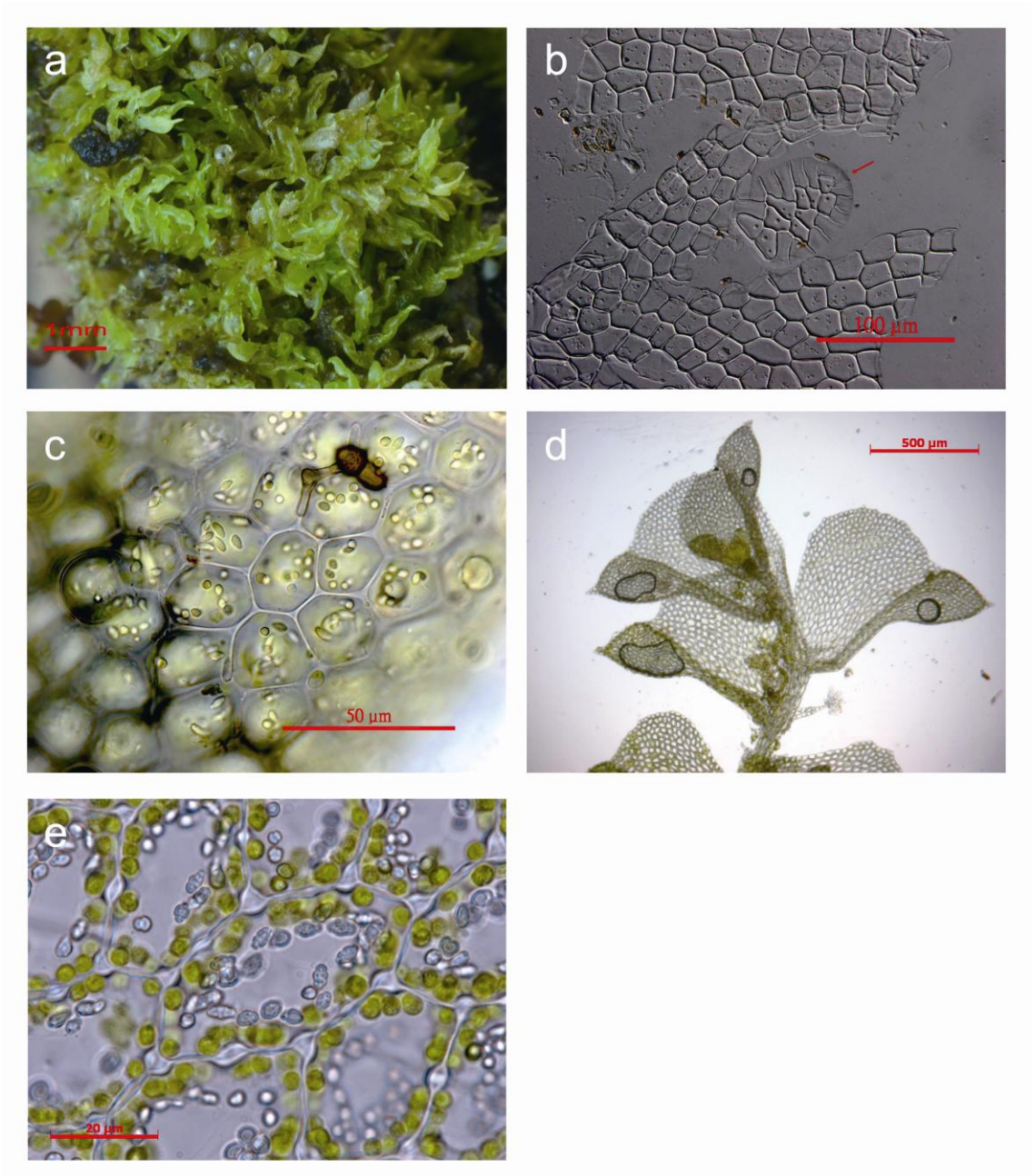

Fig. 3. ***Colura calyptrifolia*** (Hook.) Dumort.: a. plants; b, valve (arrowed); c, oil bodies in the median cells of leaf lobe. (All photographed from *J. -D. Yang 7313*); ***Colura conica*** (Sande Lac.) K.I.Goebel: d. ventral view of a portion of plant; e. oil bodies in the median cells of leaf lobe. (d. photographed from *J. -D. Yang 4,680m*; e. photographed from *J. -D. Yang 4647f*).