



Original Article

Note on *Notothylas yunannensis* (Notothyladaceae, Anthocerotophyta), a little known species of hornwort

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Abstract

Notothylas yunannensis T. Peng & R.L. Zhu, a species of hornwort to formerly considered endemic China, is newly record for Thailand. It has been reported previously from Yunnan, China. A description, line drawing, and SEM photographs are provided.

Keywords: hornworts, *Notothylas yunannensis*, spore, taxonomy, Thailand

1. Introduction

The genus *Notothylas* Sull. is the fifth largest genus of hornworts with about 23 currently accepted species (Villarreal *et al.*, 2010; Chantanaorrapint, 2014; Peng and Zhu, 2014). The genus is widely distributed in tropical to temperate regions, and the highest species diversity of the genus is in the Indian subcontinent (Asthana and Srivastava, 1991; Singh, 2002; Frey and Stech 2009; Peng and Zhu, 2014). It is easily separated from other genera of hornworts by the capsules being very short, borne almost horizontally on the thallus, mostly enclosed within the involucre, and the epidermal cells of the capsule lacking stomata.

Only few publications have contributed knowledge of the genus *Notothylas* in Thailand, probably due to the still relatively poor bryological survey of the country (Sukkharak and Chantanaorrapint, 2014). Five species were previously known in Thailand, including: *Notothylas depressispora* J. Haseg., *N. irregularis* Chantanaorr., *N. javanica* (Sande Lac.) Gottsche, *N. levieri* Schiffn. ex Steph. and *N. orbicularis* (Schwein.) Sull. ex A. Gray (Hasegawa, 1979; Lai *et al.*, 2008; Chantanaorrapint, 2014). More new records of species are

to be expected in the unexplored areas, especially in the northern part of the country.

During fieldwork devoted to revision of the division Anthocerotophyta in Thailand, some unfamiliar collections of the genus *Notothylas* were found in the northern and north-eastern Thai floristic regions. Based on literature and herbarium specimens' comparisons, the unknown collections were identified as *N. yunannensis*, which was first established by Peng and Zhu (2014), based on only one collection from China. *Notothylas yunannensis* is one of the most mysterious and interesting, not only because it was considered endemic to China, but also for the remarkable fact that only a sample had previously been collected. This represents the first record of species from Thailand and the second report worldwide. The following description and illustration below are based on the four recent specimens from Thailand.

2. Materials and Methods

This study is based on recent collections from Thailand as well as herbarium specimens in HSNU and PSU. Morphological and anatomical characters were studied using stereo and compound microscopes. The distinctive characters of the species were illustrated with the aid of an Olympus drawing tube. Mature spores were dissected from sporangia

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and mounted on double-stick cellophane adhesive tape affixed on stubs. Spores were then plated with a thin layer of gold and examined with a FEI Quanta 400 scanning electron microscope. In addition, distribution and ecological data were compiled, and a detailed description and illustrations are provided.

3. Results and Discussion

Notothylas yunnanensis T. Peng & R.L. Zhu, Phytotaxa 156: 157. figs. 2-3. 2014. Figures 1-2.

Type: China. Yunnan: Mengla Co., Menglun to Mengbang, 636 km, on moist soil by road, 27°49.833'N, 101°20.303'E, 1155 m, 15 July 2012, T. Peng et al. 20120715-7 (holotype HSNU!).

Description: *Thalli* deep green when fresh, forming orbicular-suborbicular, fasciculate rosettes, 5-17 mm in diameter, prostrate or closely adhering to substrate, overlapping, dorsal surface smooth and flat, margin lobed, lobes narrow to broad, apex truncate or shortly lacerate, lateral margins erose; thallus 5-8 cells thick in transverse section, dorsal epidermal cells rectangular to polygonal, 44-74 × 21-64 μm, with a solitary chloroplast, pyrenoid present. *Nostoc* colonies irregularly arranged on the ventral side. *Rhizoid* hyaline, along ventral surface, inner wall smooth.

Monoicous. *Androecia* scattered, antheridia 2-6 per cavity, subglobose-oblong, 60-100 × 62-85 μm, with stalk 25-35 μm long. *Involucre*s solitary, spreading horizontally or slightly ascending, cylindrical to conical, rather thick, longitudinally deeply-plicate or lamellate. *Capsules* cylindrical, 1.5-2.5 mm high, longitudinally ruptured but not valvate, without any special row of thick-walled cells; columella well-developed, consisting of 16 cells in transverse section; assimilative tissue of 2-3 cell layers; epidermal cells subquadrate to sub-rectangular, 42-89 × 13-49 μm, irregularly arranged, moderately thick-walled; stomata lacking. *Spores* yellowish, unicellular, tetrahedral trilete, rounded-triangular in polar view, in equatorial view fan-shaped, equatorial diameter 28-36 μm; proximal portion subpyramidal, surface coarsely vermiculate, each proximal surface with a hollow at its center; distal surface much more densely vermiculate than proximal surface, with a slightly dome-like region at the center. *Pseudoelaters* few, quadrate to rectangular, 25-42 × 15-30 μm, semi-hyaline, spiral thickenings poorly developed or indistinct, usually disintegrating in the final stage of development.

Spores under SEM: The proximal face is divided into three flattened facets by prominent arms of the tri-radiate ridges; the facet is vermiculate, bearing a hollow radiating vermiculate at its center (Figure 2C). Each arm is thin, slightly wavy, and bordered by densely vermiculate tuberculate projections (Figure 2C). The distal face much more densely vermiculate than proximal surface, slightly dome-like in form (Figure 2D).

Habitat: In Thailand *Notothylas yunnanensis* was found during the rainy season growing with other bryophytes

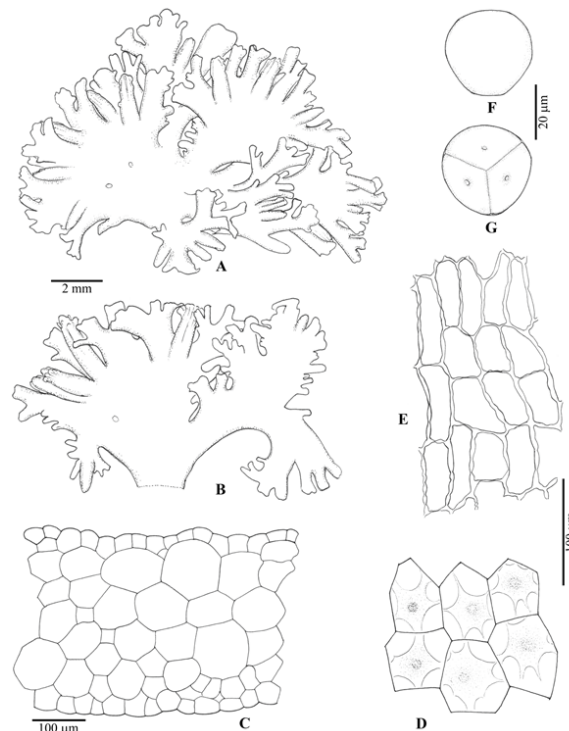


Figure 1. *Notothylas yunnanensis* T. Peng & R.L. Zhu: A-B. Gametophyte with sporophytes; C. Transverse section of thallus; D. Dorsal epidermal cells of thallus; E. Epidermal cells of the capsule; F. Distal view of spore; G. Proximal view of spore. Drawn by S. Chantanaorrapint from Chantanaorrapint & Promma 2851 (PSU).

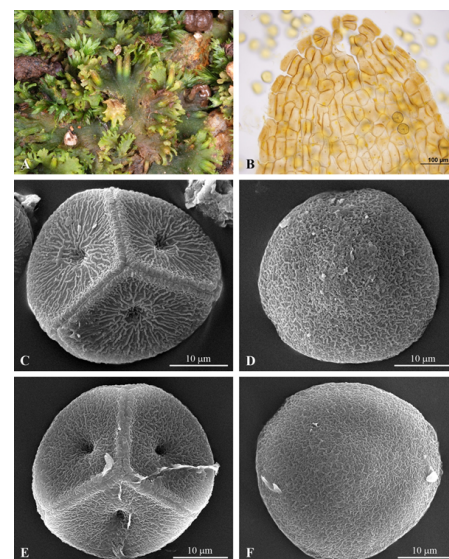


Figure 2. A-D. *Notothylas yunnanensis* T. Peng & R.L. Zhu: A. Thalli with sporophytes in its natural habitat; B. Epidermal cells of the capsule; C-D. SEMs of spores: C. Proximal view, D. Distal view. E-F. *Notothylas irregularis* Chantanaorr. SEMs of spores: E. Proximal view, F. Distal view. A-D from Chantanaorrapint & Promma 2851 (PSU). E-F. from Chantanaorrapint & Inuthai 1615 (PSU).

(Figure 2A), such as *Anthoceros erectus* Kashyap, *Fissidens* sp., *N. javanica* (Sande Lac.) Gottsche and *Phaeoceros carolinianus* (Michx.) Prosk., on disturbed soil along walking trails at ca. 600-1,200 m.

Conservation status: Its IUCN (2001) category should be treated at the moment as data deficient (DD). Because of its small size and ephemeral character, it could easily be overlooked in general botanical explorations. It is difficult to further clarify its IUCN status until further surveys of suitable habitat are undertaken.

Distribution: China (Yunnan) (Peng and Zhu, 2014), new to Thailand.

Representative specimens examined: Thailand. Chiang Rai: Doi Chang, 1,200 m, 13 August 2011, *Chantanaorrapint 2475* (PSU); Doi Tung, Doi Tung Royal Villa, 1005 m, 6 September 2013, *Chantanaorrapint & Promma 2832* (PSU); Lampang: Wang Nuea, Wang Kaew waterfall, 636 m, 7 September 2013, *Chantanaorrapint & Promma 2851* (PSU); Loei: Phu Kradueng National Park, 17 October 2013, *Chantanaorrapint & Promma 3084B* (PSU).

Taxonomic notes: *Notothylas yunnanensis* can be easily recognized by 1) the irregularly arranged, subquadrate to subrectangular epidermal cells of the capsule, 2) the absence of the special dehiscence lines of thick-walled cells along the capsule, and 3) the vermiculate ornamentation of the spores radiating from a central hollow on each proximal surface (Peng and Zhu, 2014). *Notothylas yunnanensis* is closely related to *Notothylas depressispora* J. Haseg. and *N. irregularis* Chantanaorr., which also has vermiculate spores with a small depression on each proximal facet (Figure 2). However, they can be distinguished by the shape of the epidermal cells of capsule and the spore ornamentation. Diagnostic morphological characters between these three species are summarized in Table 1.

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Table 1. Morphological comparison of *Notothylas depressispora*, *N. irregularis* and *N. yunnanensis* concerning the sporophyte characters.

Characters	<i>N. depressispora</i>	<i>N. irregularis</i>	<i>N. yunnanensis</i>
Dehiscence line	present	present	absent
Epidermal cells arrangement shape	strongly thick walled regular rectangular	moderately thick walled irregular subquadrate to subrectangular	moderately thick walled irregular subquadrate to subrectangular
Pseudoelater spiral thickenings	always present poorly developed	mostly disintegrated absent	mostly disintegrated poorly developed
Spore color ornamentation distal face proximal face size	yellowish to pale brown finely vermiculate bearing hump-like structures depression 30-32.5 mm	Pale yellow finely vermiculate dome-like depression 30-35 mm	yellowish to pale brown coarsely vermiculate dome-like depression with radiating vermiculate 28-36 mm
Columella	poorly developed	well developed	well developed

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