

## The genus *Plagiochasma* (Aytoniaceae, Marchantiopsida) in Thailand

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**Abstract** – The genus *Plagiochasma* Lehm. et Lindenb. in Thailand is reviewed, based on herbarium specimens and especially on recently collections. The genus is reported for the first time from Thailand. Two species are recognized, namely *P. appendiculatum* Lehm. et Lindenb. and *P. cordatum* Lehm. et Lindenb. Descriptions, illustrations, and a key to species are provided.

**Aytoniaceae / complex thalloid liverworts / Marchantiopsida / *Plagiochasma* / Thailand**

### INTRODUCTION

Thailand is well-known as one of the richest areas in term of biodiversity. This area is located in both the Indo-Burmese and Sundaland hotspots (Myers *et al.*, 2000), and includes areas identified as the overlapping zone of the Sino-Himalayan and Malesian floristic regions (Smitinand, 1989). The first report for liverworts in Thailand was made by Stephani (1902) who recorded seventeen species of liverworts from Koh Chang (Island), including four new species. During 1901-1904, Hosseus collected plant specimens from the northern part of the country, and reported five liverworts (Hosseus, 1911). Later, many contributions of Thai liverworts were received. In 2008, Lai *et al.* published an updated checklist of Thai liverworts and hornworts based on the literatures and their currently collections, including 376 species of liverworts. In recent years, some additions of interesting liverworts to Thailand have been reported (Kornochalert *et al.*, 2010; He *et al.* 2012, 2013; Kornochalert *et al.*, 2012; Wei & Zhu 2013; Sukkharak, 2013).

The genus *Plagiochasma*, a member of the family Aytoniaceae, was established by Lehmann and Lindenb. in 1832, based on *P. cordatum* Lehm. et Lindenb. from Nepal (Lehmann, 1832). It contains 16 species, which are usually growing on calcareous substrates (Bischler-Causse *et al.*, 2005). *Plagiochasma* is distributed mainly in warm-temperate and tropical regions of the world, an indication of its xeromorphic adaptations (Bischler, 1978, 1979; Bischler-Causse *et al.*, 2005; Cros *et al.*, 2005; Long, 2006; Frey & Stech, 2009). It is easily separated from other genera of Aytoniaceae by the 1) leathery and strongly xeromorphic thallus, 2) absence of rhizoid furrow in the archegoniophore stalks, 3) subspherical archegonial head with bivalved involucre, and 4) antheridia in cushions bounded by scales, on dorsal or at base of apical adventitious branches.

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While a comprehensive taxonomic revision of *Phagiochasma* in Asia and Ocenia was published by Bischler (1979), the genus was unreported from Thailand (Lai *et al.*, 2008) probably due to the rareness of bryological surveys in this country (Sukkharak & Chantanaorrapint, 2014). During fieldwork devoted to the revision of the class Marchantiopsida in Thailand, the recently collected specimens were found in limestone areas of northern and southern-western Thai floristic regions. Based on literature and herbarium comparisons, the unknown collections were identified as *P. appendiculatum* Lehm. *et* Lindenb. and *P. cordatum*, which are new records for Thailand. The discovery is hardly surprising, as the previously recognized distribution of these two species virtually surrounds northern Thailand. They possibly also occur in the north-eastern Thai floristic region because there are similar mountains and habitats, especially in limestone areas.

## MATERIALS AND METHODS

This study is based on recent collections from Thailand as well as herbarium specimens in BKF, CMU 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 of *P. cordatum* were dissected from sporangia 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 detailed descriptions, illustrations and a key to species are provided.

## TAXONOMIC TREATMENT

There are two species of *Plagiochasma* occurring in Thailand: *P. appendiculatum* and *P. cordatum*. Keys for distinguishing these two species are as below:

1. Ventral scales with a single appendage; appendages orbicular or broadly ovate, margin subentire. . . . . *P. appendiculatum*
1. Ventral scales with 2(-3) appendages; appendages narrowly triangular, margin nearly entire to irregularly dentate . . . . . *P. cordatum*

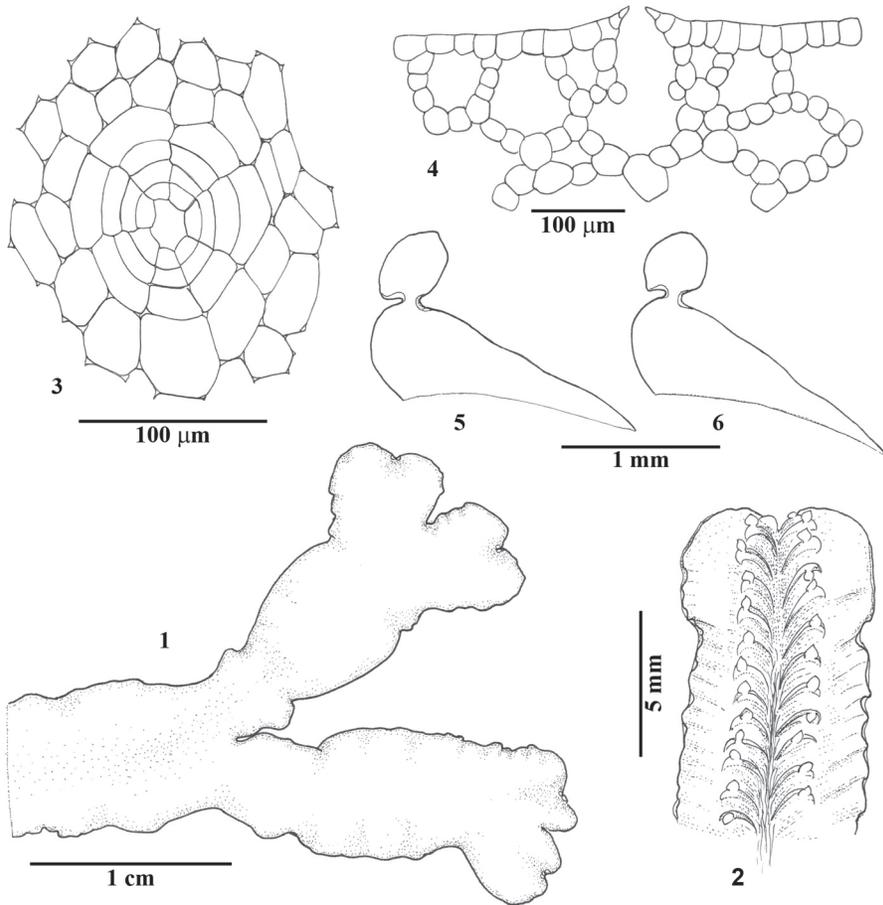
***Plagiochasma appendiculatum* Lehm. *et* Lindenb., in Lehmann, *Nov. Stirp. Pug.***

4: 14. 1832

**Figs 1-6**

**Type** (Bischler, 1978): India, Punjab, *Wallich s.n.* (lectotype, W).

Thallus 4.5-8.0 mm wide, up to 35 mm long, dorsally bright to dark green, smooth and faintly areolate, margins brown-purple, slightly undulate; apical adventitious branches few. Epidermal cells 28-35 × 24-30 μm, with small-sized to medium trigones. Epidermal pores simple, raised above epidermis, bounded by 2-3(-4) concentric rings of (5-)-6-8(-10) cells. Ventral scales purple, margin of 3-4 rows of light brown or hyaline cells; appendage large, single, orbicular or broadly ovate, purplish in the central part with hyaline border, obtuse or rounded at apex, constricted at base; margins subentire with papillae. Reproductive structures not seen.



Figs 1-6. *Plagiochasma appendiculatum*. **1.** Dorsal view of thallus. **2.** Ventral view of thallus. **3.** Dorsal view of airpore. **4.** Transverse section of airpore. **5-6.** Scales. All from *Chantanaorrapint & Promma 1681* (PSU).

**Habitat:** In this study, *Plagiochasma appendiculatum* grows on moist and shady soil along roadside banks, between 1200 and 1400 m together with other bryophytes such as *Anthoceros subtilis* Steph., *Lunularia cruciata* (L.) Dumort. ex Lindenb., *Notothylas orbicularis* (Schwein.) Sull. and *Phaeoceros carolinianus* (Michx.) Prosk. **Distribution:** *Plagiochasma appendiculatum* is widely distributed in Afghanistan, China, Eritrea, Ethiopia, India, Kenya, Nepal, Pakistan, Philippines, South Africa, Tanzania, Spain (Balearic Islands), Vietnam, and Zimbabwe (Bischler, 1979; Cros *et al.*, 2005). **New to Thailand.**

**Specimens examined:** Chiang Mai, Doi Suthep-Pui National Park, 1392 m 18°80'460"N, 98°89'758"E, 6 October 2012, *Chantanaorrapint & Promma 1681* (PSU, BKF); 8 September 2013, *Rattanamanee 37* (PSU); 11 January 2014, *Printarakul 6448* (CMU).

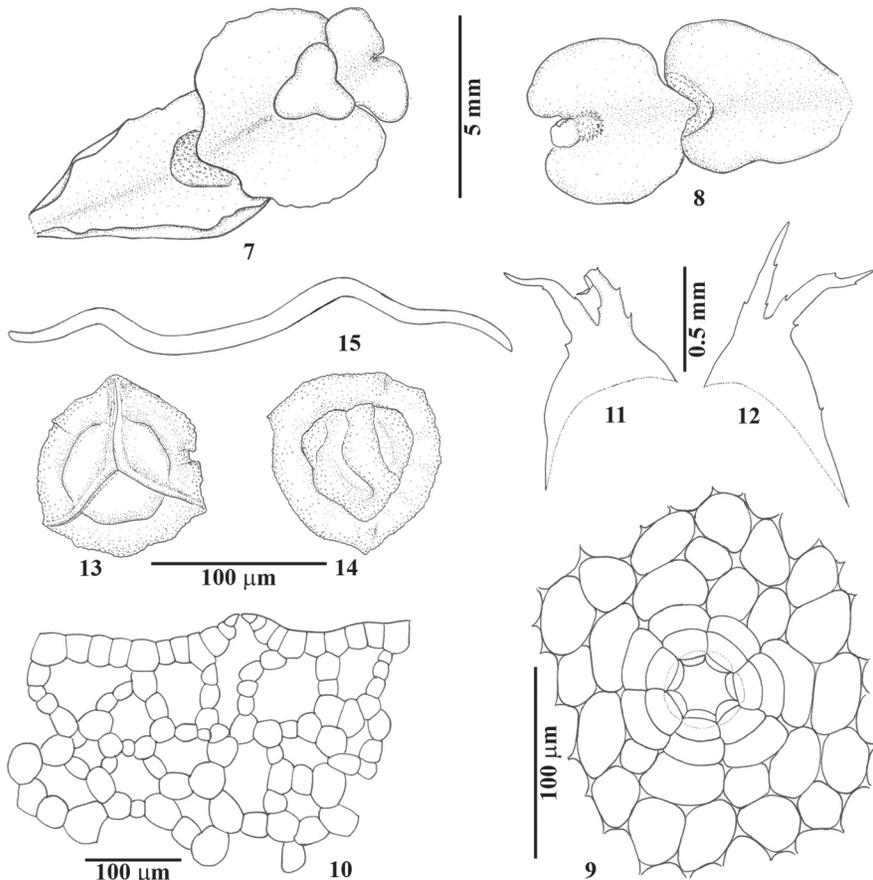
**Taxonomic notes:** *Plagiochasma appendiculatum* is easily separated from other Asian species by having ventral scales with orbicular to broadly ovate appendages which are constricted at base.

*Plagiochasma cordatum* **Lehm. et Lindenb.**, in *Lehmann, Nov. Stirp. Pug.* 4: 13. 1832

**Figs 7-19**

**Type:** Nepal, *Wallich s.n.* (holotype FH; isotypes BM, G, NY, S-PA).

Thallus 3.5-5.5 mm wide, up to 30 mm long, dorsally dark green, smooth and faintly areolate; ventrally purple; margins purple, slightly undulate; apical and lateral adventitious branches frequently, generally heart-shaped. Epidermal cells 28-35 × 24-30 μm, with medium trigones. Epidermal pores simple, raised above epidermis, bounded by 2-3 concentric rings of (5-)6-8 cells. Ventral scales purple, margin slightly dentate; appendages 2, rarely 3, narrowly triangular, acuminate, purplish, not constricted at base; margins irregularly dentate. Monoicous. Male receptacle sessile, horse shoe-shaped, dorsal at the apical region of adventitious branch. Archegoniophore dorsal at apical region of thallus or adventitious branches; stalk very short, 0.5-1.0 mm long; receptacle 2-3 lobed; dorsal surface nearly smooth. Sporophyte with a very short seta; capsule ovoid, ca. 0.5 mm long.



Figs 7-15. *Plagiochasma cordatum*. 7-8. Dorsal view of thallus. 9. Dorsal view of airpore. 10. Transverse section of airpore. 11-12. Scales. 13-14. Spores, 13. Proximal view, 14. Distal view. 15. Elater. All from *Chantanaorrapint & Promma 2796* (PSU).

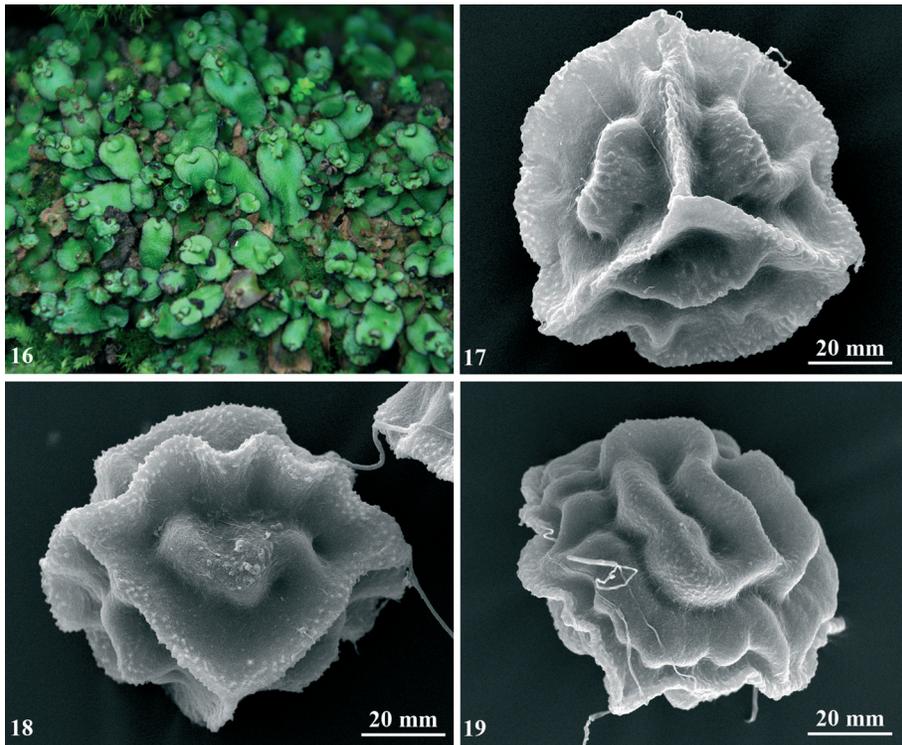
Spores yellowish-brown to dark brown, 93-110  $\mu\text{m}$  in diameter, triangular-spherical, tetrahedral, distal surface covered with numerous small tuberculate projections; proximal face with triradiate mark, lamellae rare; dorsal face with prominent irregularly distributed lamellae, more or less forming incomplete reticulation. Elaters yellowish-brown, usually devoid of spirals or rarely with 2-3 interrupted spirals, 250-300  $\mu\text{m}$  long.

**Habitat:** In Thailand, the species is found associated with *Asterella wallichiana* (Lehm. et Lindenb.) Grolle, on calcareous substrates, between 850 and 2190 m.

**Distribution:** *Plagiochasma cordatum* is a Sino-Himalayan species, distributed in Afghanistan, Bhutan, China, India, Nepal (Bischler, 1979). **New to Thailand.**

**Specimens examined:** Chiang Mai Province, Chiang Dao District, Doi Chiang Dao Wildlife Sanctuary, Doi Song Pee-Nong 1450 m, 19°38'261"N, 98°84'701"E, 6 September 2012, *Chantanaorrapint & Inuthai 1571* (PSU), 7 October 2012, *Chantanaorrapint & Promma 1712* (PSU, BKF), Doi Luang, summit of Doi Chiang Dao, 2190 m, 9 September 2012, *Chantanaorrapint & Inuthai 1594* (PSU), 30 October 2013, *Chantanaorrapint & Promma 3130* (PSU, BKF); Tak Province, Umpang District, Doi Hua Mod, 850 m, 15°58'33.23"N, 98°50'13.59"E, 24 October 2012, *Chantanaorrapint 2621* (PSU), 13 August 2013, *Chantanaorrapint & Promma 2796* (PSU, BKF).

**Taxonomic notes:** *Plagiochasma cordatum* is similar to *P. pterospermum* C.Massal. in having 2-3 narrowly triangular appendages of the ventral scales. The latter, however, is easily separated by smaller thallus and reticulation of spores.



Figs 16-19. *Plagiochasma cordatum*. **16.** Habitat. **17-19.** SEMs of spores from *Chantanaorrapint 2621* (PSU). **17.** Proximal view, **18.** Equatorial view, **19.** Distal view.

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