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A genus *Schizotrema* (Graphidaceae) new to China, with a world-wide key

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Abstract: Based on the specimens collected from Yunnan Province, the lichen genus *Schizotrema* Mangold & Lumbsch is reported as new to China, with the species *S. guadeloupense* (Hale) Mangold & Lumbsch. Among Graphidaceae, the genus is characterized by its ascomata with concentrically layered margins composed of carbonized excipular remnants of older hymenia; the proper exciple is fused to indistinctly free, periphysoids are usually present, and the ascospores are transversely septate to muriform. The species also is new to Asia. Notes of other five species in the genus are given, also with ecology and distribution. World-wide key to species of *Schizotrema* be presence in the present paper. This study provides the basic data for the taxonomy of the family Graphidaceae.

Key words: Cryptogamae, taxonomy, lichenized fungi, Ostropales, new record

中国地衣新记录属——裂孔衣属

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摘要: 报道了中国文字衣科地衣一新记录属——裂孔衣属(*Schizotrema* Mangold & Lumbsch)及其 1 个新记录种, 即瓜岛裂孔衣[*Schizotrema guadeloupense* (Hale) Mangold & Lumbsch], 标本来自云南。该属主要特征: 地衣体壳状, 树皮生, 具子囊盘类或色盘衣类的子囊果, 子囊果具再生层状边缘, 固有盘被融合或不明显, 具侧生侧丝, 子囊孢子横隔透镜或砖壁型。该种也是亚洲新记录种。本文对该属其他 5 种进行了特征提要, 以及对其生态分布作了描述。本研究为文字衣科地衣的分类学研究提供了基础资料。

关键词: 孢子植物, 分类学, 地衣型真菌, 厚顶盘目, 新记录

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Introduction

The genus *Schizotrema* Mangold & Lumbsch belonging to Graphidaceae, Ostropales Ostropomycetidae, Lecanoromycetes, Pezizomycotina, Ascomycota, only comprises six species in Thelotreroid-Graphidaceae (Kalb, 2009; Mangold et al, 2009; Lumbsch et al, 2010; Rivas Plata et al, 2010, 2012, 2013; Lücking et al, 2016). It was rather recently established to accommodate species with rounded ascomata and a layered margin formed by concentrically arranged remnants of carbonized excipular tissue from older hymenia. In recent years, some small genera of Graphidaceae are reported in China, such as Thelotreroid genera *Chapsa* (Xu et al, 2016) and *Myriotrema* (Xu et al, 2015), and Graphioid genera *Carbacarthographis* (Jia et al, 2017; Liu et al, 2018), *Fissurina* (Jia et al, 2018) and *Leiorreuma* (Wang et al, 2015). In the present paper, the genus *Schizotrema* with its one species is reported as new to China.

Based on specimens collected from Yunnan Province, this genus is here newly reported from China, with a single species, *Schizotrema guadeloupense*.

1 Materials and Methods

The specimens are deposited in the Lichen Herbarium of the College of Life Sciences, Liaocheng University, China (LCU). OLYMPUS SZX16 and TECH XTS-30D dissecting microscopes, and OLYMPUS BX53 compound microscope were used for the morphological and anatomical studies, which were conducted as described in Jia & Wei (Jia & Wei, 2016).

2 Descriptions

Schizotrema Mangold & Lumbsch, *in* Mangold, Elix & Lumbsch, Fl. Australia 57: 657 (2009).

Type species: *Schizotrema zebrinum* Mangold.

Thallus corticolous, crustose, pale grey to yellowish-green, smooth to rough. Photobiont trentepohlioid. Apothecia erumpent to prominent, ±rounded, apothecioid but usually with a narrow pore, regenerating with concentrically layered excipula and laterally covered by thalline layer, concolorous with the thallus; excipula more or less carbonized, periphysoids usually present; new hymenia formed from below the previous hymenia; ascospores transversely septate or muriform, non-amyloid.

Chemistry: β-orcinol depsidones, or no lichen substances present.

Notes: *Schizotrema* is characterised by erumpent to prominent, apothecioid ascomata with regenerating hymenia resulting in a ±distinctly layered margin, with an apically free proper exciple that is dark brown to carbonised, a strongly conglutinated hymenium, distinct lateral paraphyses, ascospores transversely septate to muriform, hyaline to yellowish or brownish at late maturity. The genus grows on bark and wood and is found world-wide, with a concentration of species in Australia, mainly in cool-temperate and warm-temperate rainforest, less commonly in subtropical and tropical habitats. *Schizotrema* is most similar to *Topeliopsis* Kantvilas & Vězda, but differs in the carbonized excipula. Several other genera of thelotremoid Graphidaceae form lateral paraphyses, viz. *Acanthotrema* Frisch, *Chapsa* A. Massal., *Melanotopelia* Lumbsch & Mangold, *Pseudoramonia* Kantvilas & Vězda, *Schizotrema* Mangold & Lumbsch, *Thelotrema* Ach., and *Topeliopsis* Kantvilas & Vězda. except for *Melanotopelia* and *Schizotrema*, these have a non-carbonized excipulum, and *Melanotrema* differs from *Schizotrema* in the simple, non-layered excipulum. *Crutarndina* Parmen, Lücking & Lumbsch agrees with *Schizotrema* in the layered excipulum but has only the apical portion carbonized and both genera are phylogenetically unrelated.

Schizotrema guadeloupense (Hale) Mangold & Lumbsch Fig. 1

in Mangold, Elix & Lumbsch, Fl. Australia 57: 657 (2009). –*Thelotrema guadeloupense* Hale, *Phytologia* 26: 416 (1973); type: Guadeloupe, Parc National de Guadeloupe, M.E. Hale 31633; holo: US!.

Thallus partially endoperidermal, pale greyish green to pale olive, dull to glossy, smooth to rough, corticate; cortex 15–20 μm thick; photobiont layer continuous.

Ascomata rounded to somewhat irregular, erumpent, 0.5–0.8 mm diam., regenerating with layered margins. Disc usually hidden by excipular material, pore 0.2–0.4 mm diam., rounded to angular, formed by the apices of the innermost excipular tissue. Proper exciple usually apically free, dark brown to carbonized and usually containing periderm cells. Hymenium 150–200 μm high; periphysoids conspicuous. Epithecium indistinct. Asci 8-spored. Ascospores richly muriform, ellipsoid to fusiform, with rounded to subacute ends, hyaline to brownish at late maturity, non-amyloid, 40–70 \times 15–20 μm , locules rounded to angular; ascospore wall thin, non-halonate, I–.

Chemistry: Stictic acid (major) and constictic acid (minor).

Notes. *Schizotrema guadeloupense* is similar to *S. schizolomum* (Müll. Arg.) Mangold & Lumbsch, but the latter species has larger ascospores (60–180 \times 20–40 μm) and produces salazinic acid. *Schizotrema cryptotrema* (Nyl.) Rivas Plata & Mangold is also somewhat similar, but differs in the rather cryptic ascomata and the psoromic acid chemistry.

Ecology and distribution: In China, the species grows on bark, known from tropical primeval forest of Mountain Daweishan in Yunnan Province, Southwest China. Associated lichens include species of *Graphis*. It was previously reported from the Antilles (Guadeloupe), Argentina, Australia (including Tasmania), and New Zealand (Mangold et al, 2009; Lumbsch et al, 2010) and is new to China and to both continental and tropical Asia.

Specimens examined: **China. Yunnan Prov.:** Gejiu City, Manhao Town, Malongdi, 1 280 m, 23 November 2011, Z.F. Jia 11-488, 11-493 (LCU).

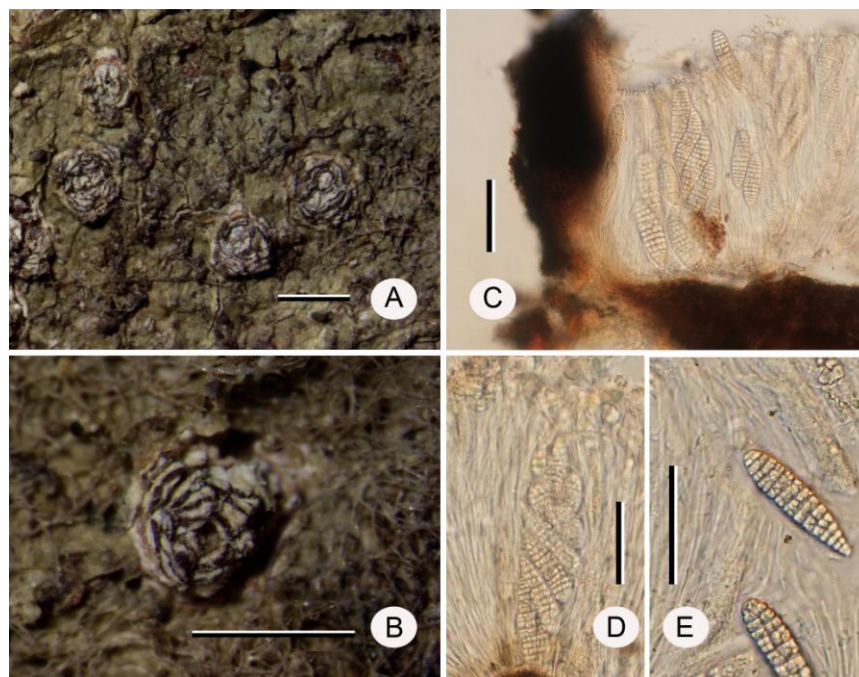


Fig. 1. *Schizotrema guadeloupense* (specimen: Z.F. Jia 11-488). **A, B**. Thallus (Scales = 1 mm); **C**. Asci with ascospores (Scale = 50 μm); **D, E**. Asci with ascospores (Scale = 20 μm).

Notes on other five species of *Schizotrema* in the world

Schizotrema cryptotrema (Nyl.) Rivas Plata & Mangold,

in Rivas Plata, Lücking, Sipman, Mangold, Kalb & Lumbsch, *Lichenologist* **42**(2): 184 (2010).
—*Thelotrema cryptotrema* Nyl., *Annls Sci. Nat., Bot.*, s. 5 **7**: 319 (1867).

Schizotrema cryptotrema is characterized by ascomata morphological cryptic, with indistinctly layered; ascospores muriform; presence of psoromic acid.

Ecology and Distribution: On bark. French Guiana, Brazil, Costa Rica (Nylander, 1867; Redinger, 1936), Venezuela (Klaus Kalb, 2009).

Schizotrema flavolucens (Sipman) Lücking

in Lücking, Mangold & Lumbsch, *Herzogia* **29**: 506 (2016). —*Myriotrema flavolucens* Sipman, *Trop. Bryol.* **6**: 5 (1992).

Schizotrema flavolucens is characterized by conspicuous, layered ascomata with carbonized proper exciple; asci 8-spored; ascospores hyaline, non-amyloid, 18–25 \times 7–11 μm , transversely septate, with (3–) 5 (–6) locules; presence of lichexanthone.

Ecology and Distribution: On twigs in humid savannah vegetation on sandstone flats at tableland. Venezuela (Sipman 1992).

Schizotrema schizolomum (Müll. Arg.) Mangold & Lumbsch

in Mangold, Elix & Lumbsch, *Fl. Australia* **57**: 657 (2009). —*Leptotrema schizoloma* Müll. Arg., *Nuov. Giorn. Botan. Ital.* **21**: 49 (1889)

Schizotrema schizolomum is characterized by regenerating, distinctly layered and carbonized ascomata; 1–4 (–6) spored asci; large, thin walled, mainly non-amyloid, muriform ascospores sized 60–180 \times 20–40 μm ; presence of salazinic acid or no lichen substances.

Ecology and Distribution: On bark and wood in cool-temperate to warm-temperate rainforests. Tasmania, New Zealand, Argentina, Australia (Mangold et al, 2009; Lumbsch et al, 2010).

Schizotrema subzebrinum Mangold

in Mangold, Elix & Lumbsch, *Fl. Australia* **57**: 657 (2009).

Schizotrema subzebrinum is characterized by inconspicuous, erumpent, distinctly layered and distinctly carbonized ascomata; asci 8-spored; ascospores hyaline, non-amyloid, 20–35 \times 7–10 μm , submuriform, with 10–14 \times 1–2 (–3) locules; absence of lichen substances.

Ecology and Distribution: On bark in warm-temperate rainforest. NSW (Mangold et al, 2009).

Schizotrema zebrinum Mangold

in Mangold, Elix & Lumbsch, *Fl. Australia* **57**: 657 (2009).

Schizotrema zebrinum is characterized by conspicuous, layered ascomata with carbonized thick Proper exciple; asci 6–8-spored; ascospores hyaline, non-amyloid, 30–80 \times 6–11 μm , transversely septate, with 12–22 locules; presence of variable chemistry containing stictic acid, constictic acid, conprotocetraric acid, protocetraric acid, and so on (major to absent).

Ecology and distribution: On bark in cool-temperate to warm-temperate and tropical montane rainforests. Australia (Mangold et al, 2009), New Zealand (Lumbsch et al, 2010).

World-wide key to species of *Schizotrema*

- 1a. Ascospores transversely septate..... 2
 1b. Ascospores (sub-) muriform 3
 2a. Ascospores 30–80 × 6–11 μm, with 12–22 locules; stictic or fumarprotocetraric acids present *S. zebrinum* Mangold
 2b. Ascospores 18–25 × 7–11 μm, with (3–)5(–6) locules; lichexanthone present*S. flavolucens* (Sipman) Lücking
 3a. Ascospores submuriform, 20–35 × 7–10 μm; no lichen substances..... *S. subzebrinum* Mangold
 3b. Ascospores muriform, 35–180 × 15–40 μm; chemistry variable.....4
 4 a. Ascospores 60–180 × 20–40 μm; salazinic acid or no lichen substances.....*S. schizolomum* (Müll. Arg.) Mangold & Lumbsch
 4b. Ascospores 35–80 × 15–30 μm; psoromic or stictic acid or cinchonarum unknowns.....5
 5a. Stictic acid (major) and constictic acid (trace); apothecia with distinctly layered margins..... *S. guadeloupense* (Hale) Mangold & Lumbsch
 5b. Psoromic acid present; apothecia morphologically cryptic, with indistinctly layered margins *S. cryptotrema* (Nyl.) Rivas Plata & Mangold

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References:

- JIA ZF, LI J, YANG MZ, 2017 *Carbacanthographis* (Graphidaceae), a lichen genus new to Guangxi [J]. *Guihaia*, 37(2): 231–233. [贾泽峰, 李健, 杨梦竹, 2017. 广西地衣新记录属——炭刺文衣属 [J]. *广西植物*, 37(2): 231–233.]
 JIA ZF, LÜCKING R, LI J, et al, 2018. A preliminary study of the lichen genus *Fissurina* (Graphidaceae) in China [J]. *Mycosystema*, 37(7): 881–895.
 JIA ZF, WEI JC, 2016. *Flora lichenum sinicorum – Ostropales (I) – Graphidaceae 1* [M]. Beijing: Science Press, 13: 1–210. [贾泽峰, 魏江春, 2016. *中国地衣志·厚顶盘目 (I) 文字衣科 (1)* [M]. 北京: 科学出版社出版, 13: 1-210.]
 KALB K, 2009. New taxa and new records of thelotremoid Graphidaceae[J]. *Herzogia*, 22: 17-42
 LIU FY, DOU MZ, ZHENG XJ, et al, 2018. A new record species of lichen genus *Carbacanthographis* to China [J]. *J Liaocheng Univ (Nat Sci Ed)*, 31: 80–82. [刘飞月, 豆明珠, 郑晓佳, 等, 2018. 中国炭刺文衣属地衣一新记录种 [J]. *聊城大学学报 (自然科学版)*, 31: 80–82.]
 LÜCKING R, MONGOLD A, LUMBSCH HT, 2016. A world wide key to species of the genera *Myriotrema* and *Glaucotrema* (lichenized Ascomycota: Graphidaceae), with anomenclatural checklist of species published in *Myriotrema* [J]. *Herzogia*, 29 (2): 493-513.
 LUMBSCH HT, DIVAKAR PK, MESSUTI MI, et al, 2010. A survey of thelotremoid lichens (Ascomycota: Ostropales) in subantarctic regions excluding Tasmania [J]. *Lichenologist*, 42(2):

- 203–224.
- MANGOLD A, ELIX JA, LUMBSCH HT, 2009. Thelotremataceae [J]. Flora of Australia, 57: 195–420.
- NYLANDER W, 1867. Lichenes, Additamentum. – In: Trina, J. & Planchon, J. E.: Prodromus florae NovoGranatensis ou Énumération des plantes de la Nouvelle-Grénade avec description des espèces nouvelles [J]. Ann Sci Nat, s. 5 (Bot), 7: 301–354.
- REDINGER K, 1936. Thelotremaceae brasilienses imprimis ex herbario Regnelliano cognitae praeterea in herbariis Krempelhuberi, Mülleri Arg., Nylanderi, Wainionis et Zahlbruckneri asservatae [J]. Ark Bot, 28A(8): 1–122.
- RIVAS PLATA E, LÜCKING R, SIPMAN HJM, et al, 2010. A world-wide key to the thelotremoid Graphidaceae, excluding the *Ocellularia-Myriotrema-Stegobolus* clade [J]. Lichenologist, 42(2): 139–185.
- RIVAS PLATA E, LÜCKING R, LUMBSCH HT, 2012. A new classification for the family Graphidaceae (Ascomycota: lecanoromycetes: Ostropales) [J]. Fungal Divers, 52: 107–121.
- RIVAS PLATA E, PARNMEN S, STAIGER B, et al, 2013. A molecular phylogeny of Graphidaceae (Ascomycota, Lecanoromycetes, Ostropales) including 428 species [J]. Mycokeys, 6: 55–94.
- SIPMAN HJM, 1992. Results of a lichenological and bryological exploration of Cerro Guaiquinima (Guyana Highland, Venezuela) [J]. Trop Bryol, 6: 1–33.
- WANG XH, XU LL, JIA ZF, 2015. The lichen genus *Leiorreuma* in China [J]. Mycotaxon, 130: 247–251.
- XU LL, JIA ZF, 2015. Lichen genus *Myriotrema* and species *M. viridialbum* new to China [J]. J Fung Res, 13(3): 132–135.
- XU LL, WU QH, WANG QD, et al, 2016. *Chapsa* (Graphidaceae, Ostropales), a lichen genus new to China [J]. J Trop Subtrop Bot, 24(5): 495–498. [徐丽丽, 吴青华, 王启栋, 贾泽峰, 2016. 中国地衣新记录属——裂衣属 [J]. 热带亚热带植物学报, 24(5): 495–498.]