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SHORT COMMUNICATION

New species and records of *Heteroconium* (anamorphic fungi) from southern China

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Abstract Four anamorphic fungal species of *Heteroconium* were collected from tropical and subtropical forests in southern China. Among them, *Heteroconium tsoongiodendronis* sp. nov. and *Heteroconium fici* sp. nov. are described from specimens collected on dead branches of *Tsoongiodendron odorum* and *Ficus gibbosa*, respectively. Two species of *Heteroconium*, *H. decorosum* and *H. ponapense*, are recorded for the first time in China. A key to *Heteroconium* and related genera is also provided.

Keywords Conidial fungi · Hyphomycetes · Taxonomy

Introduction

The genus *Heteroconium* Petr. was erected by Petrak (1949) with *Heteroconium citharexyli* Petr. as the type species. It is characterized by superficial or immersed hyphae, macronematous, mononematous conidiophores with monoblastic, terminal, determinate, or percurrent conidiogenous cells producing euseptate, fusiform, cylindrical to oblong conidia that arise in acropetal unbranched chains (Petrak 1949; Ellis 1971; Castañeda et al. 1999). The conidiophores are unbranched or with a secondary branch originating after conidial secession or near-percurrent proliferations (Taylor et al. 2001; Castañeda et al. 2008). Assigning species in *Heteroconium* is primarily based on conidial morphological characters, including shape, septation, size, pigmentation, and ornamentation. Castañeda et al. (2008) provided a key to 16 species of this genus, including *Heteroconium solaninum* (Sacc. & P. Syd.) M.B. Ellis (Ellis 1976). To date, *Heteroconium* contains 16 valid taxa, 1 of which has been described from China (Zhang et al. 2010).

Species of *Heteroconium* grow on various substrates such as dead twigs, wood, and live and decaying leaves, and are widely distributed in the tropical and temperate regions of the world. Southern China lies from 20°N to 34°N and from 98°E to 123°E and occupies one fourth of the country's territory. The average elevation is less than 500 m; annual mean temperature ranges from 15 ° to 22 °C; and total annual precipitation ranges from 1,000 to 2,000 mm. The vegetation is mostly composed of evergreen broadleaf forests and rainforests in this marine monsoon zone. Fungal diversity in southern China is high, and more than 150 wood-inhabiting fungi have been recently discovered there (Dai et al. 2009; Dai and Li 2010; Ma et al. 2011, 2012). Located in the south of China, Fujian, Yunnan, and Hainan Provinces cover an area of 570,000 km^2 and possess various plants, fungi, and other organisms owing to the warm moist climate. In our ongoing study of anamorphic fungi from this area, four species with morphological characters of *Heteroconium* were collected from dead branches. They are proposed herein as two new species and two new records.

Specimens of decomposed woody debris were collected from tropical and subtropical forests in Fujian, Hainan, and

The specimens studied are deposited in Herbarium of the Department of Plant Pathology, Shandong Agricultural University (HSAUP) and Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS) (http://hmas.im.ac.cn).

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Yunnan Provinces, southern China, from August to November, 2008–2010. For each sampling site, 100 specimens were collected. All the samples were placed in separate polyethylene bags (15 × 22 cm) and transported to the laboratory. The specimens were incubated in plastic boxes containing sterilized damp tissue paper at about 25 °C in an RXZ-260A Artificial Climate Box (Jiangnan, Ningbo, China) for more than 3 weeks and then examined by an Olympus SZ61 dissecting microscope (Olympus, Japan). Conidia and conidiophores were taken from the surface of the wood with a needle, transferred to a drop of lactophenol [lactic acid 20 %, glycerol 40 %, phenol 20 %, distilled water 20 % (v/v)] on a slide, and then the excess lactophenol was evaporated in a DHP-9052 drying oven (Yiheng, Shanghai, China) at 55 °C. Finally, the slides were sealed with neutral balsam. All microscopic characters were determined on the basis of measurements of 50 mature conidia and 30 conidiophores mounted in lactophenol. The measurements are presented as ranges and mean ± standard deviation. The photographs were obtained by an Olympus BX51 microscope (Olympus, Japan). The specimens are deposited in the Herbarium of the Department of Plant Pathology, Shandong Agricultural University (HSAUP) and Mycological Herbarium, Institute of Microbiology, Chinese Academy of Sciences (HMAS) (http://hmas.im.ac.cn).

Taxonomy

Heteroconium tsoongiodendronis L.G. Ma & X.G. Zhang, sp. nov. Fig. 1

MycoBank no.: MB 561129

Conidiophores macronematous, mononematous, simple, erect, unbranched, straight or slightly flexuous, cylindrical, smooth, thick walled, brown, 7–10-septate, 140–180 × 4.5–7.5 (means ± SD, 160 ± 4.5 × 6.0 ± 1.5) µm. Conidiogenous cells monoblastic, terminal, integrated, brown, smooth, with 1–4 cylindrical percurrent proliferations, 7.0–12.5 × 6.5–8.0 (means ± SD, 10 ± 2.5 × 7.0 ± 0.6) µm. Conidial secession schizolytic. Conidia holoblastic, acrogenous, blastocatenate, in chains of up to 3, constrictions in intact chains, smooth, ellipsoidal, brown, thick walled, 20–25 × 7–10 (means ± SD, 23 ± 2.0 × 8.5 ± 1.5) µm, (1–)2-septate.

Typus: China, Fujian Province, Wuyishan national nature reserve (27°35′N, 117°53′E), on dead branches of *Tsoongiodendron odorum* Chun (Magnoliaceae), 14 August 2009, leg. L.G. Ma (holotypus, HSAUP H1025; isotypus, HMAS 146096).

Etymology: *tsoongiodendronis*, in reference to the host genus *Tsoongiodendron*.

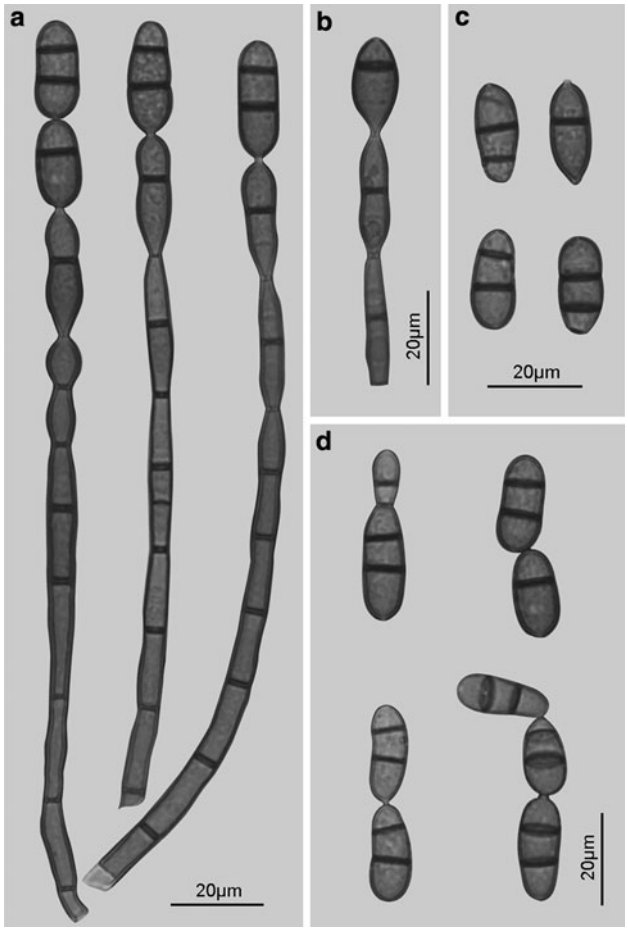

Fig. 1 *Heteroconium tsoongiodendronis* (HSAUP H1025). **a** Conidiophores and conidia. **b** Conidiophore apex showing conidiogenous cell and percurrent proliferations. **c** Detached conidia. **d** Catenate conidia

Note: *Heteroconium tsoongiodendronis* resembles *H. ponapense* Matsush. (Matsushima 1983) in conidial shape. However, *H. tsoongiodendronis* produces wider (7–10 µm) and mainly 2-septate conidia whereas *H. ponapense* has narrower (4–6 µm) and 1-septate conidia. *Heteroconium tsoongiodendronis* also bears some morphological resemblance to *H. lignicola* Panwar & Chauhan (Panwar and Chauhan 1977), but differs from it by having ellipsoidal conidia with fewer septa and rounded ends. Furthermore, *H. tsoongiodendronis* has obviously longer conidiophores (140–180 µm) than those of *H. ponapense* (15–30 µm) and *H. lignicola* (up to 25 µm).

Heteroconium fici L.G. Ma & X.G. Zhang, sp. nov. Fig. 2

MycoBank no.: MB 561130

Conidiophores macronematous, mononematous, simple, erect, unbranched, straight or slightly flexuous, cylindrical, smooth, thick walled, dark brown, (7–)10–14(–17)-septate, up to 140 µm long, 6.0–7.5 (means ± SD, 110 ± 5.7 × 6.8 ± 0.7) µm wide. Conidiogenous cells monoblastic,

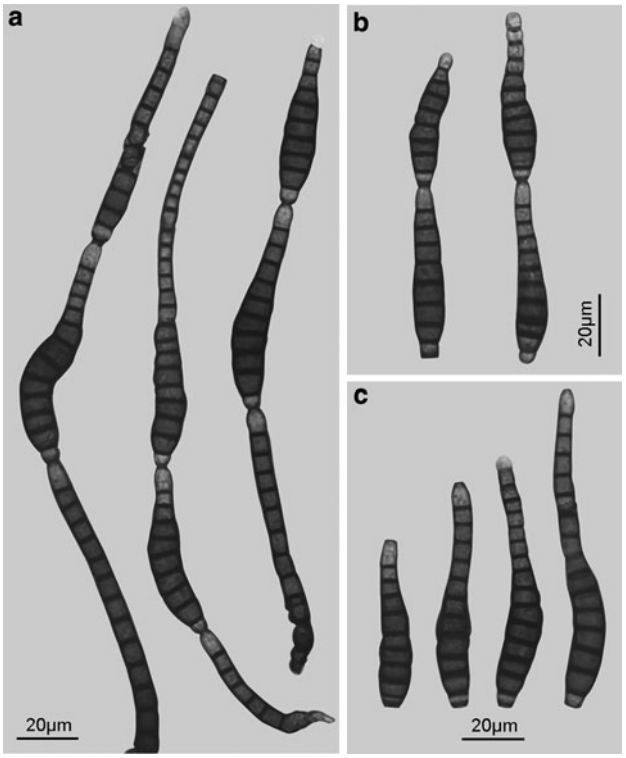

Fig. 2 *Heteroconium fici* (HSAUP H0326). **a** Conidiophores and conidia. **b** Catenate conidia. **c** Detached conidia

terminal, cylindrical, integrated, determinate or percurrent, brown, smooth, truncate at the apex, 8.5–10.5 × 6.0–7.0 (means ± SD, 9.5 ± 1.0 × 6.5 ± 0.5) μm. Conidial secession schizolytic. Conidia holoblastic, acrogenous, blastocatenate, smooth, obclavate, brown, unevenly pigmented, pale brown ends, thick walled, in chains of two, 45–110 × 8–12 (means ± SD, 82.5 ± 7.2 × 10.0 ± 2) μm, 8–18-septate, truncate at the base.

Typus: China, Yunnan Province, Xishuangbanna tropical botanical garden (22°18′N, 99°21′E), on dead branches of *Ficus gibbosa* Bl. (Moraceae), 19 October 2008, leg. L.G. Ma (holotypus, HSAUP H0326; isotypus, HMAS 146097).

Etymology: *fici*, in reference to the host genus *Ficus*.

Note: *Heteroconium fici* is unique in this genus in producing typically obclavate, dark brown, and smooth conidia. It is most similar to *H. arundicum* Chowdhry (Chowdhry 1980) in conidial size, but *H. arundicum* can be easily separated by its cylindrical to fusiform and 1–10-septate conidia.

Heteroconium decorosum R.F. Castañeda, Saikawa & Guarro, Mycotaxon 71: 297 (1999) Fig. 3

Conidiophores macronematous, mononematous, simple, erect, unbranched, straight, cylindrical, thick walled, smooth, 3–6-septate, brown to dark brown, 30–65 × 5–8 (means ± SD, 50 ± 5.7 × 6.5 ± 1.5) μm. Conidiogenous

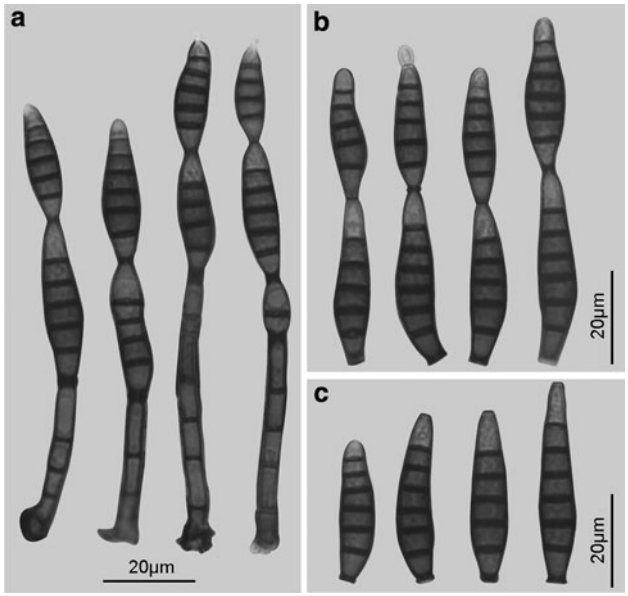

Fig. 3 *Heteroconium decorosum* (HSAUP H0087). **a** Conidiophores and conidia. **b** Catenate conidia. **c** Detached conidia

cells monoblastic, terminal, integrated, cylindrical, determinate, pale brown to brown, smooth, truncate at the apex, 7.0–15.0 × 4.5–6.5 (means ± SD, 11.5 ± 2.7 × 5.5 ± 1.0) μm. Conidial secession schizolytic. Conidia holoblastic, acrogenous, blastocatenate, smooth, broad fusiform to obclavate, thick walled, brown to dark brown, pale brown ends, truncate at the base, rounded at the apex, in chains up to three, 21.5–50 × 7–10 (means ± SD, 39 ± 5.2 × 8.5 ± 1.5) μm, 4–8-septate.

Specimens examined: China, Yunnan Province, Xishuangbanna tropical botanical garden (22°24′N, 99°45′E), on dead branches of *Cinnamomum porrectum* (Roxb.) Kosterm. (Lauraceae), 20 October 2008, leg. L.G. Ma (HSAUP H0087, HMAS 146098); China, Hainan Province, Jianfengling National Nature Reserve (18°42′N, 108°55′E), on dead branches of *Polyalthia laui* Merr. (Annonaceae), 22 November 2008, leg. L.G. Ma (HSAUP H0577, HMAS 146099).

Note: *Heteroconium decorosum* is recorded for the first time from China. It is closely related to *H. avilae* R.F. Castañeda, Iturr., Heredia & Minter (Castañeda et al. 2008) in conidial shape, but the latter can be distinguished by its much shorter conidia with fewer septa (23–33 μm, 1–3). Our two collections fit well with the type specimen, except that ours have slightly smaller conidiophores.

Heteroconium ponapense Matsush., Matsush. Mycol. Mem. 3: 11 (1983) Fig. 4

Conidiophores macronematous, mononematous, simple, erect, unbranched, straight, cylindrical, smooth, thick walled, brown, 4–8-septate, 95–110 × 4.5–5.5 (means ± SD,

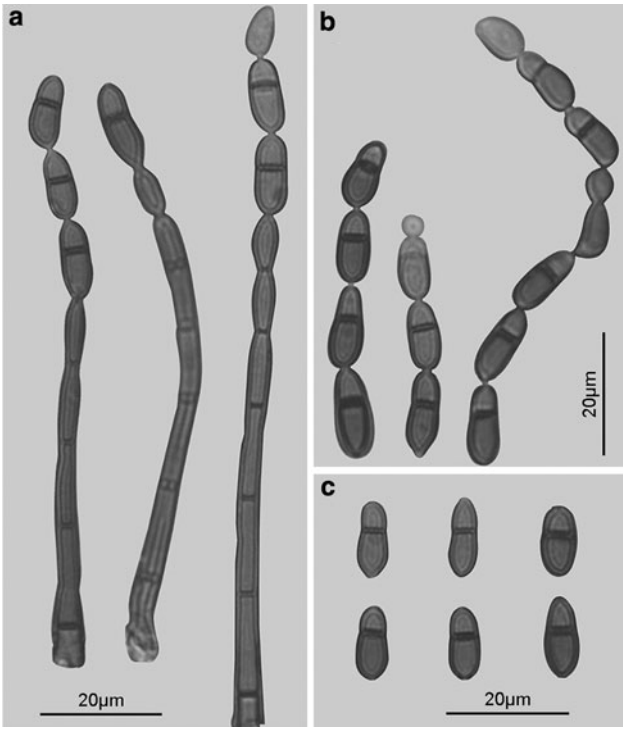

Fig. 4 *Heteroconium ponapense* (HSAUP H1835). **a** Conidiophores and conidia. **b** Catenate conidia. **c** Detached conidia

102 ± 4.2 × 5.0 ± 0.5) μm. Conidiogenous cells monoblastic, terminal, integrated, cylindrical, brown, smooth, thick walled, with up to three percurrent proliferations, 5.5–10 × 4.5–5.5 (means ± SD, 7.5 ± 2.4 × 5.0 ± 0.5) μm. Conidial secession schizolytic. Conidia holoblastic, acrogenous, blastocatenate, in chains up to seven, smooth, ellipsoidal or ovoid, brown, thick walled, 10–14 × 4.5–6.5 (means ± SD, 12 ± 1.7 × 5.5 ± 1.0) μm, 1-septate.

Specimens examined: China, Hainan Province, Bawangling national natural reserve (19°10′N, 109°01′E), on dead branches of *Beilschmiedia intermedia* Allen (Lauraceae), 25 November 2010, leg. L.G. Ma (HSAUP H1835, HMAS 146129).

Note: *Heteroconium ponapense* is unique in this genus in producing ellipsoidal to obclavate, 1-septate conidia. The Chinese specimen differs from the type material by its shorter conidia (10–14 vs. 12–24 μm) and longer conidiophores (95–110 vs. 15–30 μm). This is the first record from China

Key to *Heteroconium* and its related genera

1. Conidia distoseptate……*Lylea*[6]
1. Conidia euseptate……2
2. Conidiogenous cells monoblastic……3
2. Conidiogenous cells polyblastic or mostly polyblastic…… 4
3. Conidia frequently in branched chains……6
3. Conidia frequently in unbranched chains……8
4. Conidiophores frequently micronematous; conidia mainly 0–1-septate……*Cladophialophora*[7]
4. Conidiophores macronematous; conidia multiseptate……5
5. Conidia in branched chains; conidiogenous cells sympodial……*Septonema*[1]
5. Conidia in unbranched chains; conidiogenous cells not sympodial……*Pleurotheciopsis*[5]
6. Conidiophores macronematous; conidia secede without difficulty……7
6. Conidiophores semi-macronematous or micronematous; conidia secede only with difficulty……*Taeniolella*[3]
7. Conidiophores paler toward the apex; conidia 0–3-septate, arising terminally……*Parapleurotheciopsis*[8]
7. Conidiophores darker toward the apex; conidia 3–7-septate, usually arising laterally…*Xenoheteroconium*[9]
8. Conidiophores semi-macronematous or micronematous; conidia with a dark band at the septum……*Bispora*[1]
8. Conidiophores macronematous; conidia without a dark band at the septum……9
9. Conidia mostly 0-septate……10
9. Conidia 1-septate or multiseptate……11
10. Superficial hyphopodiate mycelium absent; conidiophores short and arising from sporodochia… ……*Xylohypha*[4]
10. Superficial hyphopodiate mycelium present; conidiophores longer and not arising from sporodochia… ……*Ampullifera*[4]
11. Fungicolous hyphomycetes; conidial septation sequence centrifugal……*Pirozynskiella*[10]
11. Sooty molds or necrotrophic hyphomycetes; conidial septation sequence basifugal……*Heteroconium*[2]

[1]Corda (1837), [2]Petrak (1949), [3]Hughes (1958), [4]Deighton (1960), [5]Sutton (1973), [6]Morgan-Jones (1975), [7]Borelli (1980), [8]Kirk (1982), [9]Bhat and Kendrick (1993), [10]Hughes (2007).

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