Four new species of *Crocicreas* (*Helotiales*, *Leotiomycetes*) from China

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Summary: *Crocicreas* species from China are reviewed and nine species are accepted. Four of them with unique set of specific morphological characteristics are described as new: *C. boreosinicae*, *C. korfii*, *C. minisporum*, and *C. xinjiangensis*. *Crocicreas boreosinicae*, *C. korfii* and *C. xinjiangensis* grow on herbaceous stems, and *C. minisporum* is on decorticated wood. An apical ring of the *Hymenoscyphus* type occurs in *Crocicreas boreosinicae*, *C. korfii* and *C. minisporum*, and the apical ring of *C. xinjiangensis* appears J-. *Crocicreas albidum* is recorded for the first time from China. Descriptions and illustrations of the new species are provided. A key to the known species of the genus in China is given.
Keywords: Ascomycota, morphology, species diversity, taxonomy.

Introduction

Crocicreas Fr. was established in 1849 and typified with *C. gramineum* (Fr.) Fr. About 63 species are accepted in the genus (Kirk *et al*., 2008; Whitton *et al*., 2012). Members of the genus are growing on various substrates, which have small, stipitate to subsessile apothecia, whitish to brownish hymenium, ectal excipulum composed of gelatinized *textura intricata*, *textura oblita* or *textura porrecta*, cylindrical to clavate asci with a J+ or J- iodine reaction at apical portion, non-septate to multi-septate ascospores ellipsoid, ovoid, obpyriform, fusiform or filiform in shape (Carpenter, 1981).

In Carpenter's monographic treatment of *Crocicreas*, *Cyathicula* De Not. was treated as a later synonym (Carpenter, 1981). Some authors considered *C. gramineum*, the type species of *Crocicreas*, differing from other members of the genus, such as paraphysis shape (cylindrical and lanceolate vs. cylindrical and clavate), ascus apical ring (*Calycina*-type vs. *Conchatium*-type, *Hymenoscyphus*-type or J-), and absence of refractive vacuolar bodies in paraphyses; and thus restricted *Crocicreas* to include only the type species by placement of the others in *Cyathicula* (Baral & Krieglsteiner, 1985; Triebel & Baral, 1996; Chlebicka & Chlebicki, 2007; Baral *et al*., 2013). The above treatment was confirmed by phylogenetic analysis of internal transcribed spacer (ITS) and large subunit of the nuclear ribosomal DNA sequence (Baral *et al*., 2015). Considering their similarity in apothecial anatomy and phylogeny based on more comprehensive studies are required, we intend to treat Crocicreas in a relatively broad sense (Carpenter, 1981).

Bisporella Sacc. is also similar to *Crocicreas* but apothecia are often with orange and yellow tints, ectal excipular hyphae arrange differently, and sometimes associated with dematiaceous hyphomycetes (Carpenter, 1981). Recently, Baral *et al.* (2013) treated *Bisporella* in a strict sense to only include species with a *Hymenoscyphus*-type apical ring and multiguttulate paraphyses, therefore, transferred some *Bisporella* species having a *Calycina*-type of ascus apical ring and presence of elongate vacuoles in paraphyses to *Calycina* Nees ex Gray based on the phylogenetic analysis of ITS sequences. However, ectal excipular structure of *Bisporella* species is quite different from that of *C. herbarum* (Pers.) Gray, the type species of *Calycina*. Considering the above mentioned distinctions in apothecial anatomy and tissue gelatinization, we follow, for the time being, the generic concepts of *Bisporella* by Korf & Carpenter (1974) and Lizoň & Korf (1995).

Compared with *Allophylaria* (P. Karst.) P. Karst., it differs from *Crocicreas* in relatively small apothecia, parallel-arranged ectal excipular hyphae which are less ramified and hard to be stained, as well as its relatively large ascospores (Carpenter, 1981).

The first Chinese *Crocicreas* species was recorded by Tai (1979) under the name *Phialea cyathoidea* (Bull.) Gillet. Four more species were subsequently added (Whitton, 1999; Wang & Pei, 2001; Wang, 2002). In this study, *Crocicreas* specimens collected from different regions of China were examined. Four new species are proposed. *Crocicreas albidum* Raitv. & H.D. Shin is recorded from China for the first time. The previous record of *C. fuscum* (W. Phillips & Harkn.) S.E. Carp. from China was based on mis-identification and should be excluded from the Chinese fungus flora. A total of nine *Crocicreas* species are known from the country.

Material and methods

Material: Voucher specimens were collected from Anhui, Beijing, Gansu, Hebei, Heilongjiang, Hubei, Ningxia, Qinghai, Sichuan, Xinjiang and Yunnan provinces during 1989-2014, and deposited in the Herbarium Mycologicum Academiae Sinicae (HMAS).

Methods: Habitat and gross morphology of fresh apothecia were recorded according to the field notes. Dried apothecia were rehydrated with distilled water and sectioned at a thickness of 10–20 µm with a YD-1508A freezing microtome. Measurements were taken from longitudinal sections and from squash mounts in lacto-phenol cotton blue solution using an Olympus BH-2 microscope. Iodine reactions of ascus apparatus were tested in Melzer's reagent and Lugol's solution (IKI) with or without 3% KOH pre-treatment according to Baral (2009). Photographs were taken using a Leica M125 stereomicroscope for gross morphology and a Zeiss Axio Imager A2 microscope or a Canon G5 digital camera connected to a Zeiss Axioskop 2 Plus microscope for anatomical structures. All of the measurements and photographs were taken from dried and dead material.

Taxonomy

New species

Crocicreas boreosinicae H.D. Zheng & W.Y. Zhuang, *sp. nov*. – FN570209 – Fig. 1

Holotype: China, Hebei, Wulingshan, Lianhuachi, alt. 1800 m, on herbaceous stems (dicotyledon), 26.VIII.1989, W.Y. Zhuang 499 (HMAS 271403).

Etymology: The specific epithet refers to the occurrence of the fungus in northern China.

Apothecia scattered, discoid, drying concave, with margin smooth, stipitate to long stipitate, 1.5–4.5 mm in diam.; hymenium surface yellow, drying orange; receptacle surface paler than the hymenium, slightly downy; stipe cylindrical, concolorous and homogenous with the receptacle, 1–2 mm long. **Ectal excipulum** of *textura prismatica* to *textura porrecta*, hyphae parallel to or oriented at a low angle to receptacle surface, immersed in a gel except for the outmost 2–3 hyphal layers, with or without crystals, 12–33 µm thick, cells hyaline, moderately thick-walled, 9–20 × 2–5 µm. **Medullary excipulum** of two layers, outer layer of *textura porrecta*, 30–90 µm thick, inner layer of *textura intricata*, 20–205 µm thick; hyphae hyaline, 2–5 µm wide. **Subhymenium** about 40 µm thick. **Hymenium** 88–96 µm thick. **Asci** arising from croziers, 8-spored, cylindrical-clavate, with apex rounded, J+ in Melzer's reagent and Lugol's solution without KOH pre-treatment, visible as two blue lines of *Hymenoscyphus*-type, 70–97 × 7.7–8.8 µm. **Ascospores** fusoid with blunt ends, slightly flattened at one side, hyaline, smooth, 1-septate, multi-guttulate, biseriate to irregularly uniseriate, 13.2–16.5 × 3.5–4.5 µm. **Paraphyses** cylindrical, with apex rounded, hyaline, septate, unbranched, about 2.5 µm wide.

Additional specimens examined: China, Hebei, Wulingshan, Lianhuachi, alt. 1800 m, on herbaceous stems (dicotyledon), 26.VIII.1989, W.Y. Zhuang 493, 506 (HMAS 271404, 271405); Xinjiang, Hejing, Gongnaisi, alt. 2170 m, 16.VIII.2003, on stems of monocot plant, W.Y. Zhuang & Y. Nong 5009 (HMAS 271406).

Notes: Among species of the genus, *Crocicreas boreosinicae* is similar to *C. coronatum* (Bull.) S.E. Carp. and *C. dolosellum* (P. Karst.) S.E. Carp. in some respects. *Crocicreas coronatum* differs in margin smooth to dentate, the ectal excipulum composed of *textura intricata*, and aseptate to 1-septate ascospores with pointed ends. *Crocicreas dolosellum* differs in having smaller apothecia (1–1.5 mm in diam.), crenulate to denticulate apothecial margin, smaller asci [(50–)55–60(–65) × 4–5 µm], and narrower ascospores [(10–)12–15(–17) × 1.5–2 µm] eguttulate or with several small guttules (Carpenter, 1981).

Crocicreas korfii H.D. Zheng & W.Y. Zhuang, *sp. nov.* – FN570210 – Fig. 2

Holotype: China, Hubei, Shennongjia, Zhangbaohe, alt. 1100 m, on herbaceous stems (dicotyledon), 17.IX.2004, W.Y. Zhuang 5776 (HMAS 245007).

Etymology: The specific epithet is under the name of the distinguished mycologist Prof. R.P. Korf.

Apothecia scattered, discoid, drying concave, with margin smooth, stipitate, 0.3–1.2 mm in diam.; hymenium surface yellow, drying whitish to grayish black; receptacle surface drying paler than the hymenium, glabrous or nearly so; stipe cylindrical, stout, drying whitish to cream, 0.3–1.0 mm long. **Ectal excipulum** of *textura oblita* to *textura intricata*, hyphae oriented at a moderate angle to receptacle surface, immersed in a gel except for the outmost 1–2 hyphal layers, without crystals, 30–96 µm thick, cells hyaline to pale brownish, moderately thick-walled, 10–30 × 1.5–5 µm. **Medullary excipulum** of *textura porrecta*, 20–140 µm thick, hyphae hyaline, 1.5–3 µm wide. **Subhymenium** not distinguishable. **Hymenium** 125–140 µm thick. **Asci** arising from simple septa, 8-spored, clavate, with apex conical, J+ in Melzer's reagent and Lugol's solution without KOH pre-treatment, visible as two blue lines of *Hymenoscyphus*-type, 123–135 × 13–20 µm. **Ascospores** elliptical-fusoid, equilateral to slightly flattened at one side, hyaline, smooth, non-septate, multi-guttulate, irregularly biseriate to uniseriate, 24–28.5 × 6–8.8 µm. **Paraphyses** subcylindrical, slightly wider at upper portion, with apex rounded, hyaline, septate, unbranched, 2–3.5 µm wide at apex and 1.5–2 µm wide below.

Additional specimen examined: China, Hubei, Shennongjia, alt. 1200 m, on herbaceous stems (dicotyledon), 15.IX.2004, W.Y. Zhuang 5674 (HMAS 271407).

Notes: *Crocicreas korfii* is clearly delimited from all known species of *Crocicreas* by its large, non-septate ascospores. *Crocicreas megalosporum* (Rea) S.E. Carp. var. *megalosporum* has non-septate ascospores of a similar length, but differs in ectal excipulum structure, J- and smaller asci (110–115 × 10–11 µm), narrower ascospores (24–30 × 5–6 µm), and growing on leaves of *Carex* sp. (Carpenter, 1981).

Crocicreas minisporum H.D. Zheng & W.Y. Zhuang, *sp. nov.* – FN570211 – Figs 3, 5a.

Holotype: China, Yunnan, Lüchun, alt. 1600 m, on decorticated wood, 30.X.1999, W.Y. Zhuang & Z.H. Yu 3224 (HMAS 271408).

Etymology: The specific epithet refers to the small-sized ascospores.

Apothecia scattered to gregarious, discoid, drying concave, with margin smooth, stipitate, 0.2–0.5 mm in diam.; hymenium surface dirty white to grayish white, drying pale orange-yellow; receptacle surface paler than the hymenium surface, glabrous; stipe cylindrical, concolorous with receptacle, up to 0.3 mm long. **Ectal excipulum** of *textura intricata* or of *textura prismatica* at very margin, without crystals, 20–105 µm thick, hyphae oriented at a low angle to the surface, immersed in a gel, hyaline, the outmost layer and margin pale brown, walls slightly roughened, 1.2–3 µm wide. **Medullary excipulum** not well-developed. **Subhymenium** about 20 µm thick. **Hymenium** about 33 µm thick. **Asci** arising from croziers, 8-spored, cylindrical-clavate, with apex rounded, J+ in Melzer's reagent and Lugol's solution without KOH pre-treatment, visible as two dark blue lines of *Hymenoscyphus*-type, 34–38.5 × 3.5–4.5 µm. **Ascospores** ellipsoid to ovoid, hyaline, smooth, non-septate, with (1–)2 guttules, uniseriate, irregularly uniseriate to irregularly biseriate, 2.2–3.5(–4) × 1.1–2.3 µm. **Paraphyses** cylindrical, with apex rounded, hyaline, septate, unbranched, 1–1.5 µm wide.

Notes: The very small, biguttulate, elliptical ascospores and poorly-developed medullary excipulum can easily distinguish *C. minisporum* from any other members of the genus. *Crocicreas epitephrum* (Berk.) S.E. Carp. has asci and ascospores in similar sizes, but differs in smaller apothecia (0.15–0.2 mm), gregarious among leaf hairs, apothecial margin collarette-like, well-developed medullary excipulum, and longer ascospores (4–5 × 1.5–2 µm) (Carpenter, 1981).

Crocicreas xinjiangensis H.D. Zheng & W.Y. Zhuang, *sp. nov.* – FN570213 – Figs 4, 5b.

Holotype: China, Xinjiang, Yili, Guozigou, alt. 1800 m, on herbaceous stems (dicotyledon), 11.VIII.2003, W.Y. Zhuang 4881 (HMAS 271411).

Etymology: The specific epithet refers to the type locality of the fungus.

Apothecia scattered, discoid, drying concave, with margin smooth to slightly denticulate, stipitate, 0.3–1.0 mm in diam.; hymenium surface yellow, drying pale tan; receptacle surface paler than hymenium; stipe cylindrical, concolorous with receptacle, 0.3–0.8 mm long. **Ectal excipulum** of *textura prismatica* to *textura porrecta*, hyphae parallel to or oriented at a low angle to receptacle surface, immersed in a gel except for the outmost 3 to more hyphal layers, with crystals, 35–75 µm thick, cells hyaline, slightly thick-walled, 15–25 × 3.5–4.5 µm. **Medullary excipulum** of two layers, outer

layer of *textura porrecta*, 5–25 µm thick, inner layer of *textura intricata*, 20–70 µm thick; hyphae hyaline, 1.5–2 µm wide. **Subhymenium** 14–22 µm thick. **Hymenium** 70–80 µm thick. **Asci** arising from croziers, 8-spored, cylindrical-clavate, with apex rounded, J- in Melzer's reagent and Lugol's solution with or without KOH pre-treatment, 55–74 × 4.5–6 µm. **Ascospores** subfusoid when young, rod-shaped at maturity, hyaline, smooth, non-septate, with two or more medium-sized guttules, biseriate above and uniseriate below in the ascus, 6–10 × 2–2.2 µm. **Paraphyses** cylindrical, with apex rounded, hyaline, septate, unbranched, 2–2.5 µm wide.

Notes: *Crocicreas nigrofuscum* (Rehm) S.E. Carp. var. *nigrofuscum*, the most similar species in the genus, resembles *C. xinjiangensis* in size of apothecia, J- ascus apical ring, and size of ascospores, but differs in apothecia drying dark brown, the outer surface of ectal excipulum with 2 to 4 layers of appressed, dark brown, encrusted hyphae, with free hyphal protrusions at margin, and without crystals in excipulum, asci smaller (45–50 × 4–5 µm), and eguttulate ascospores allantoid to suballantoid (Carpenter, 1981).

Species new to China

Crocicreas albidum Raitv. & H.D. Shin, *Mycotaxon*, 85: 333 (2003) – Fig. 6.

Apothecia scattered, discoid, stipitate, 0.6–0.8 mm in diam.; hymenium surface whitish to pinkish white; receptacle surface drying whitish, pubescent; stipe concolorous and homogenous with recep-

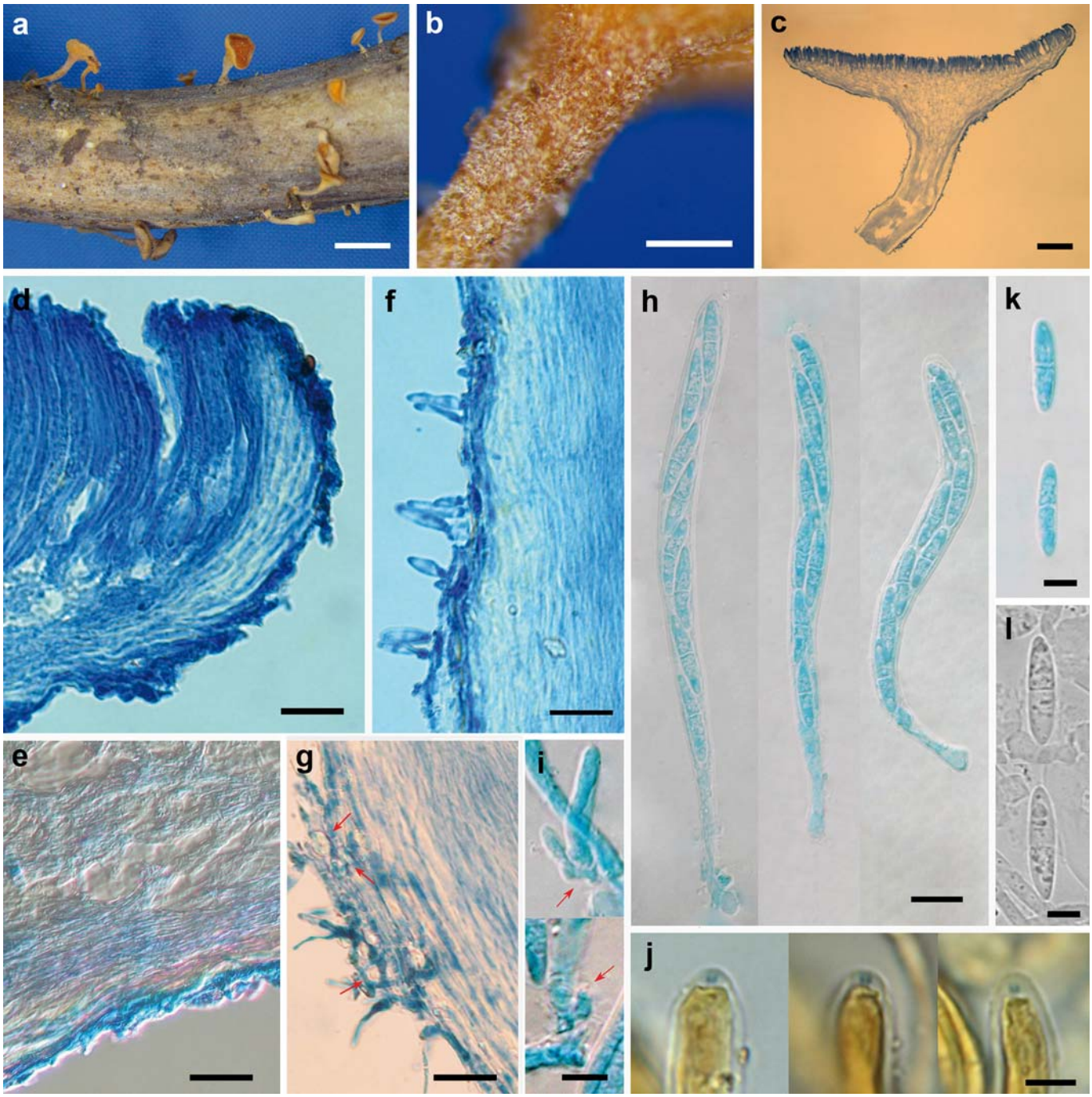

Fig. 1 – *Crocicreas boreosinicae* HMAS 271403 (holotype). a. Dry apothecia on natural substrate; b. Surface morphology of the lower receptacle and stipe (dry apothecia); c. Longitudinal section of apothecium; d. Excipular structure at margin; e. Excipular structure at flank; f. Structure in the middle of stipe ; g. Crystals in the ectal excipulum; h. Asci; i. Croziers at ascus base; j. Ascus apical rings in IKI; k. Ascospores; l. Ascospores in KOH. Scale bars: a = 2 mm, b–c = 200 µm, d–g = 20 µm, h = 10 µm, i–l = 5 µm.

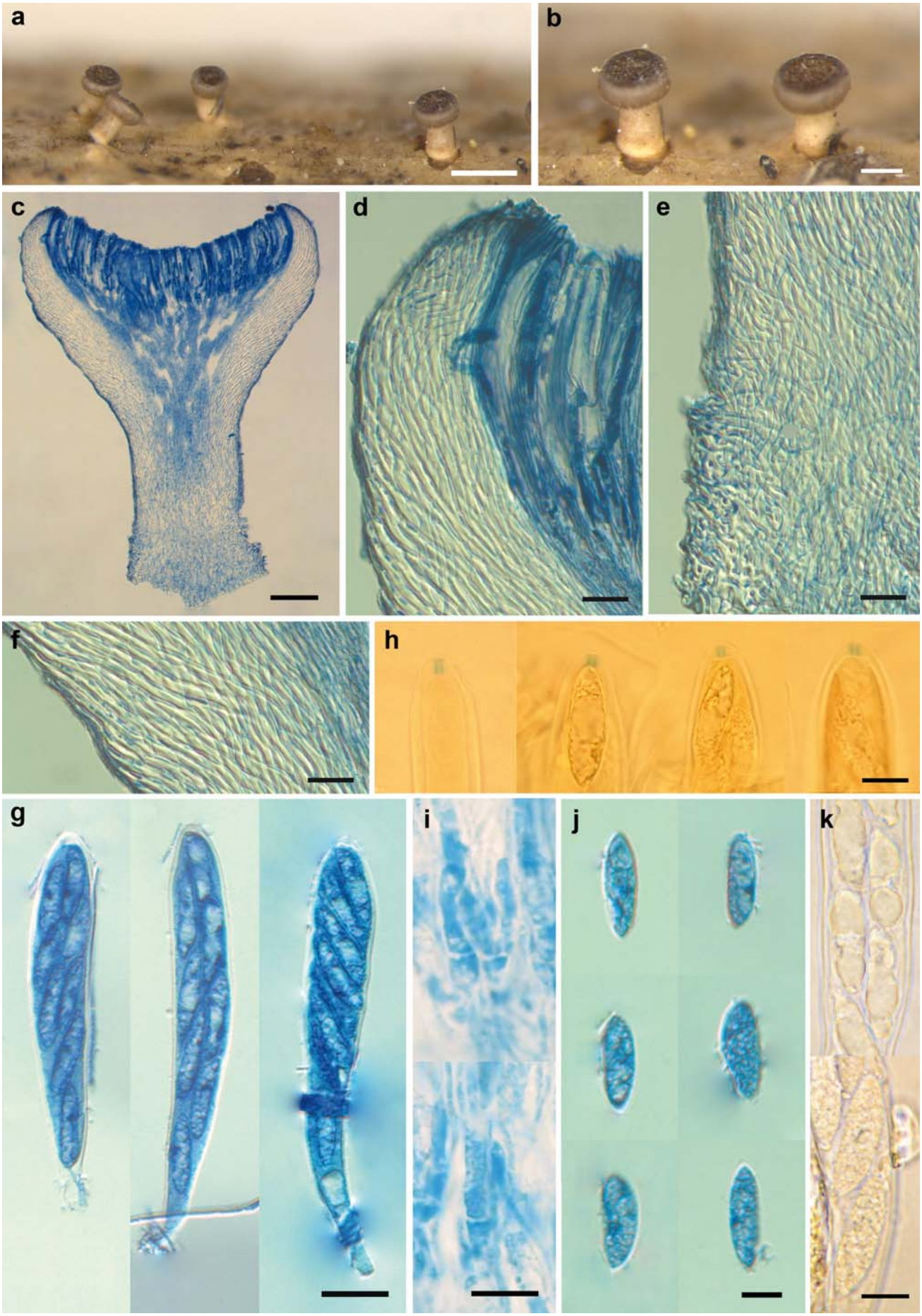

Fig. 2 – *Crocicreas korfii* HMAS 245007 (holotype). a, b. Dry apothecia on natural substrate; c. Longitudinal section of apothecium; d. Excipular structure at margin; e. Structure in the middle of stipe and near the base; f. Excipular structure at flank; g. Asci; h. Ascus apical rings in IKI; i. Simple septa at ascus base; j. Ascospores; k. Ascospores in KOH. Scale bars: a = 0.5 mm, b = 0.2 mm, c = 100 µm, d–g = 20 µm, h–k = 10 µm.

tacle, 0.3–0.4 mm long. **Ectal excipulum** of *textura prismatica*, immersed in a gel except for the outmost 2–3 hyphal layers, without crystals, 15–30 µm thick, cells hyaline, moderately thick-walled, 13–30 × 7–12 µm. **Medullary excipulum** of two layers, outer layer of *textura porrecta*, 10–16.5 µm thick, inner layer of *textura intricata*, 20–60 µm thick. **Hymenium** 60–70 µm thick. **Asci** arising from croziers, 8-spores, cylindrical-clavate, with apex rounded to subtruncate, J+ in Melzer's reagent and Lugol's solution without KOH pre-treatment, visible as two dark blue and apically obviously widened lines of *Calycina*-type, 45–56 × 4.5–5.5 µm. **Ascospores** ellipsoid, non-septate, with two large guttules, overlapping uniseriate to irregularly biseriate in the ascus, 6.5–8 × 2.5–3.3 µm. **Paraphyses** subcylindrical, about 3 µm wide at apex and 1.5–2 µm wide below.

Specimen examined: China, Anhui, Jinzhai, Tiantangzhai, alt. 900–1000 m, on very rotten leaves of an unidentified deciduous tree, 24.VIII.2011, S.L. Chen, W.Y. Zhuang, H.D. Zheng & Z.Q. Zeng 7813 (HMAS 271412).

Notes: *Crocicreas albidum* was originally described from Korea (Raitviir & Shin, 2003). Compared with Chinese material, the type specimen has larger apothecia (0.5–2 mm), smooth receptacle surface and smaller guttules in the longer and narrower ascospores (8–10 × 2–2.5 µm). The above differences are treated as infraspecific variation.

Other accepted species

Crocicreas coronatum (Bull.) S.E. Carp., *Brittonia*, 32 (2): 269 (1980).

≡ *Peziza coronata* Bull., *Herb. Fr.*, 9: tab. 416, fig. 4 (1789).

≡ *Phialea coronata* (Bull.) Gillet, *Champ. Fr., Discom.*, 4: 110 (1881) [1879].

Specimens examined: China, Beijing, Donglingshan, on herbaceous stems, 18.VIII.1998, Z. Wang 238 (HMAS 75882); Gansu, Huixian, Mayan, alt. 1360 m, 30.VIII.1992, on herbaceous stems, W.Y. Zhuang 923 (HMAS 271419); Gansu, Tewo, alt. 2600 m, on herbaceous stems, 11.IX.1992, W.Y. Zhuang 1019, 1021 (HMAS 271417, 271418); Gansu, Zhouqu, Shatan Forestry Farm, alt. 2250–2300 m, 20.VII.1998, on herbaceous stems, S.L. Chen 45a, 49a, 49b (HMAS 271414, 271415, 271416); Hebei, Wulingshan, Lianhuachi alt. 1800 m, on herbaceous stems, 26.VIII.1989, W.Y. Zhuang 491 (HMAS 271420); Heilongjiang, Yichun, Fenglin, alt. 280 m, on herbaceous stems, 27.VIII.2014, H.D. Zheng, Z.Q. Zeng & W.T. Qin 9233, 9235 (HMAS 271421, 271422); Heilongjiang, Yichun, Liangshui Forest Farm, alt. 340 m, on herbaceous stems, 28.VIII.2014, H.D. Zheng, Z.Q. Zeng & W.T. Qin 9313, 9323, 9332 (HMAS 271425, 271426, 271427); Heilongjiang, Yichun, Xiling, alt. 390 m, on herbaceous stems, 27.VIII.2014, H.D. Zheng, Z.Q. Zeng & W.T. Qin 9262, 9265 (HMAS 271423, 271424); Hubei, Shennongjia, alt. 1200 m, on herbaceous stems, 15.VIII.2004, W.Y. Zhuang & C.Y. Liu 5652, 5670, 5683 (HMAS 271429, 271430, 271431); Hubei, Shennongjia, alt. 2400 m, on herbaceous stems, 16.VIII.2004, W.Y. Zhuang & C.Y. Liu 5720 (HMAS 271432); Hubei, Shennongjia, Dalongtan, alt. 2000 m, on herbaceous stems, 13.IX.2014, H.D. Zheng, Z.Q. Zeng, W.T. Qin & K. Chen 9426 (HMAS 252907); Hubei, Shennongjia, Guogongping, alt. 1550 m, on herbaceous stems, 19.IX.2014, H.D. Zheng, Z.Q. Zeng, W.T. Qin & K. Chen 9832 (HMAS 252908); Hubei, Shennongjia, Huangbaoping, alt. 1750 m, on herbaceous stems, 16.IX.2014, H.D. Zheng, Z.Q. Zeng, W.T. Qin & K. Chen 9638 (HMAS 273728); Hubei, Shennongjia, Xiaolongtan, alt. 2100 m, on herbaceous stems,

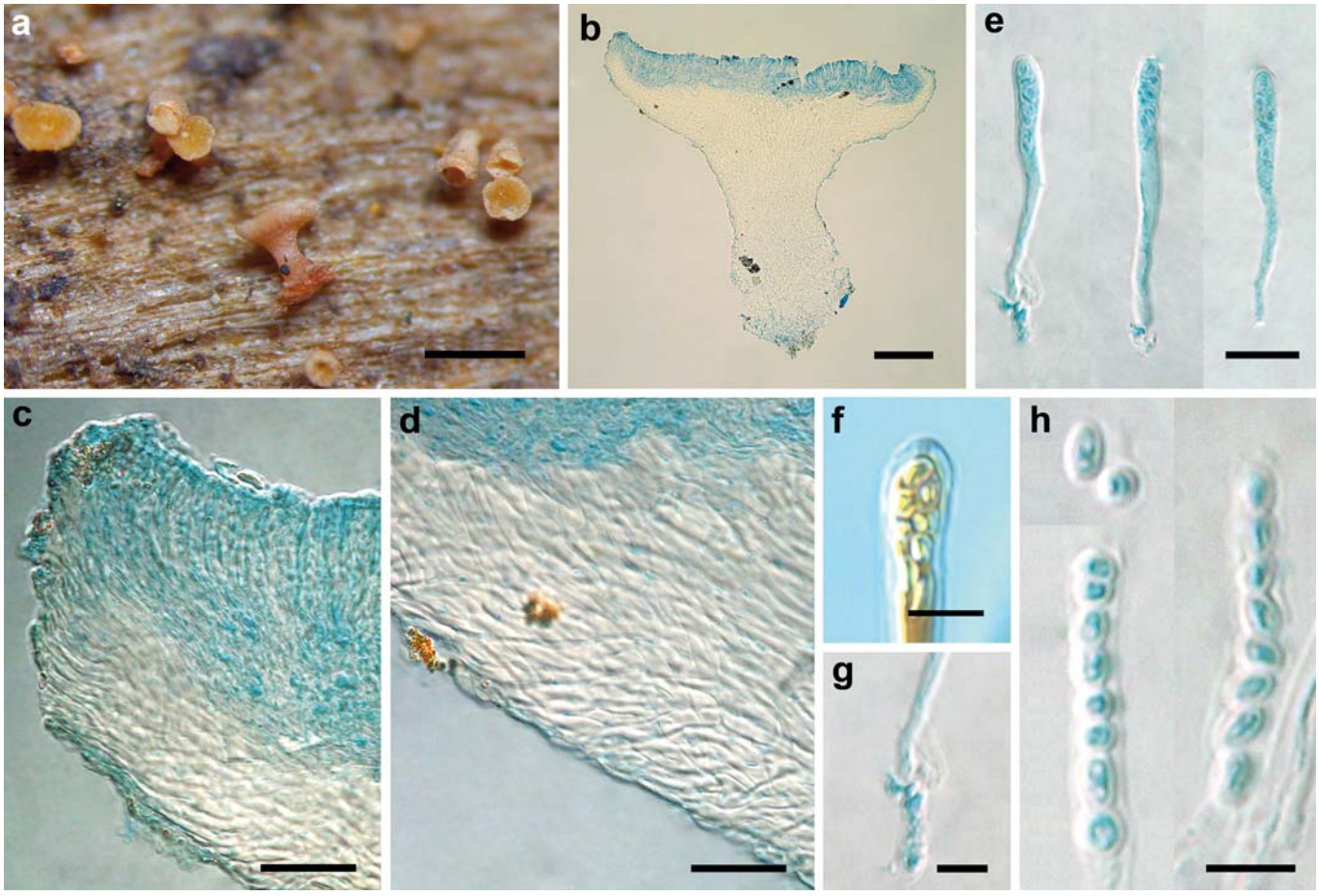

Fig. 3 – *Crocicreas minisporum* HMAS 271408 (holotype). a. Dry apothecia on natural substrate; b. Longitudinal section of apothecium; c. Excipular structure at and near margin; d. Excipular structure at flank; e. Asci; f. Ascus apical ring in IKI; g. Croziers at ascus base; h. Ascospores. Scale bars: a = 0.5 mm, b =100 µm, c–d = 20 µm, e = 10 µm, f–h = 5 µm.

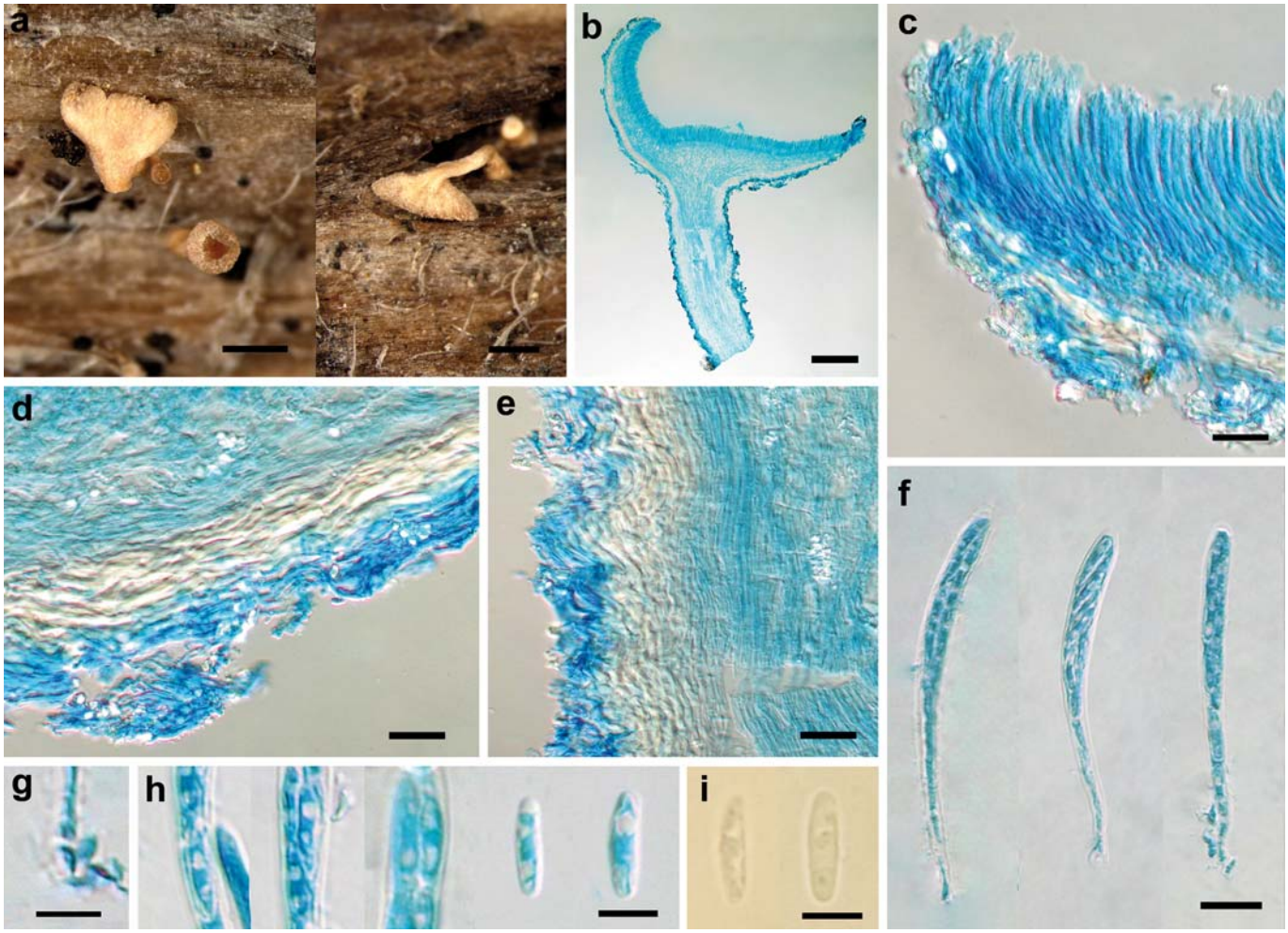

Fig. 4 – ***Crocicreas xinjiangensis*** HMAS 271411 (holotype). a. Dry apothecia on natural substrate; b. Longitudinal section of apothecium; c. Excipular structure at margin and upper flank (with crystals); d. Excipular structure at flank (with crystals); e. Structure in the middle of stipe; f. Asci; g. Croziers at ascus base; h. Ascospores; i. Ascospores in KOH. . Scale bars: a = 0.5 mm, b = 100 µm, c–e = 20 µm, f = 10 µm, g–i = 5 µm.

13.IX.2014, H.D. Zheng, Z.Q. Zeng, W.T. Qin & K. Chen 9458 (HMAS 271428); Hubei, Shennongjia, Zhangbaohe, alt. 1100 m, on herbaceous stems, 17.VIII.2004, W.Y. Zhuang & C.Y. Liu 5775, 5785, 5788 (HMAS 271433, 273726, 273727); Ningxia, Liupanshan, Erlonghe, alt. 1800 m, 23.VIII.1997, on herbaceous stems, W.Y. Zhuang & W.P. Wu 1671 (HMAS 273730); Ningxia, Liupanshan, Liangdianxia, alt. 1800 m, on herbaceous stems, 24.VIII.1997, W.Y. Zhuang & W.P. Wu 1734 (HMAS 273731); Ningxia, Liupanshan, Xixia, alt. 1800 m, on herbaceous stems, 25.VIII.1997, W.Y. Zhuang & W.P. Wu 1745 (HMAS 273732); Qinghai, Hongjungou, alt. 3690 m, on herbaceous stems, 26.VII.2013, Z.Q. Zeng, Z.X. Zhu & F. Ren 8362 (HMAS 273729); Qinghai, Minhe, Xigou, alt. 2600 m, 10.VIII.2004, on herbaceous stems, W.Y. Zhuang & C.Y. Liu 5235, 5242, 5252 (HMAS 273733, 273734, 273735); Sichuan, Barkam, Zhegushan, alt. 3300 m, on herbaceous stems, 8.IX.1997, Z. Wang 2239 (HMAS 74610).

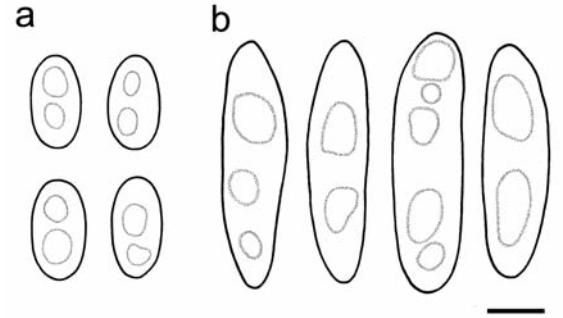

Fig. 5 – Ascospores of *Crocicreas* spp. a. *C. minisporum*, HMAS 271408; b. *C. xinjiangensis*, HMAS 271411. Scale bars = 2 µm.

Notes: Wang (2002) first reported *C. coronatum* from China based on two collections from Taiwan Province. More collections were later found from other regions. It should be a normally seen species in China. As mentioned by Carpenter (1981), morphology of *C. coronatum* is quite variable, which is also true for the Chinese materials. The margin of the apothecia varies from dentate to smooth, the number of teeth per apothecia ranges from a dozen to more than thirty, the color of hymenium changes from pale yellow to pinkish yellow, and the ascospores are either aseptate or 1-septate; which was also mentioned by Carpenter (1981) in his monographic treatment of the genus. Using ITS sequence analysis, even though showing different gross morphology, the Chinese *C. coronatum* collections clustered together as a highly supported clade. Very few nuleotide divergence were detected among samples (to be published data).

Crocicreas cyathoideum (Bull.) S.E. Carp., *Brittonia*, 32 (2): 269 (1980).

≡ *Peziza cyathoidea* Bull., *Herb. Fr.*, 9: tab. 416, fig. 3 (1789).

≡ *Phialea cyathoidea* (Bull.) Gillet, *Champ. Fr., Discom.*, 4: 106 (1881) [1879].

Specimens examined: China, Gansu, Tewo, Lazikou Forestry Farm, alt. 2200–2800 m, on herbaceous stems, 26.VII.1998, S.L. Chen 87, 104, 105 (HMAS 273742, 273743, 273744); Gansu, Zhouqu, Sha-

tan Forestry Farm, alt. 2550–2980 m, on herbaceous stems, 17.VII.1998, S.L. Chen 8a (HMAS 273736); Gansu, Zhouqu, Second Forestry Farm, alt. 3000 m, on rotten stems of *Ligularia* sp., 21.VII.1998, S.L. Chen 52, 60 (HMAS 245008, 273737); ibid., on rotten stems, 21.VII.1998, S.L. Chen 68, 73, 75 (HMAS 273738, 273739, 273740); ibid., alt. 1800 1900 m, on herbaceous stems, 21.VII.1998, S.L. Chen 85b (HMAS 273741); Qinghai, Banma, Yabagou, alt. 3755 m, on herbaceous stems, 28.VII.2013, Z.Q. Zeng, Z.X. Zhu & F. Ren 8420, 8423, 8424 (HMAS 273746, 273747, 273748); Qinghai, Minhe, Xigou, alt. 2600 m, 10.VIII.2004, on herbaceous stems, W.Y. Zhuang & C.Y. Liu 5238 (HMAS 273745); Sichuan, Daocheng, Geka, alt. 3600 m, on rotten stems of grass, 30.VIII.1997, Z. Wang 2193 (HMAS 74621); Sichuan, Songpan, Mounigou, alt. 3458 m, on herbaceous stems, 2.VIII.2013, Z.Q. Zeng, Z.X. Zhu & F. Ren 8565 (HMAS 273749); Xinjiang, Hejing, Künes, alt. 2170 m, on stems of monocot plant, 16.VIII.2003, W.Y. Zhuang & Y. Nong 5010a (HMAS 273754); Xinjiang, Qapqal, alt. 2000 m, on herbaceous stems, 13.VIII.2003, W.Y. Zhuang & Y. Nong 4925 (HKAS 273751); Xinjiang, Yili, Guozigou, alt. 1800 m, on herbaceous stems, 11.VIII.2003, W.Y. Zhuang & Y. Nong 4874a (HMAS 273750); Xinjiang, Xinyuan, Kapuhe, alt. 1500 m, on herbaceous stems, 14.VIII.2003, X.Z. Liu, W.Y. Zhuang & Y. Nong 4944, 4952 (HMAS 273752, 273753).

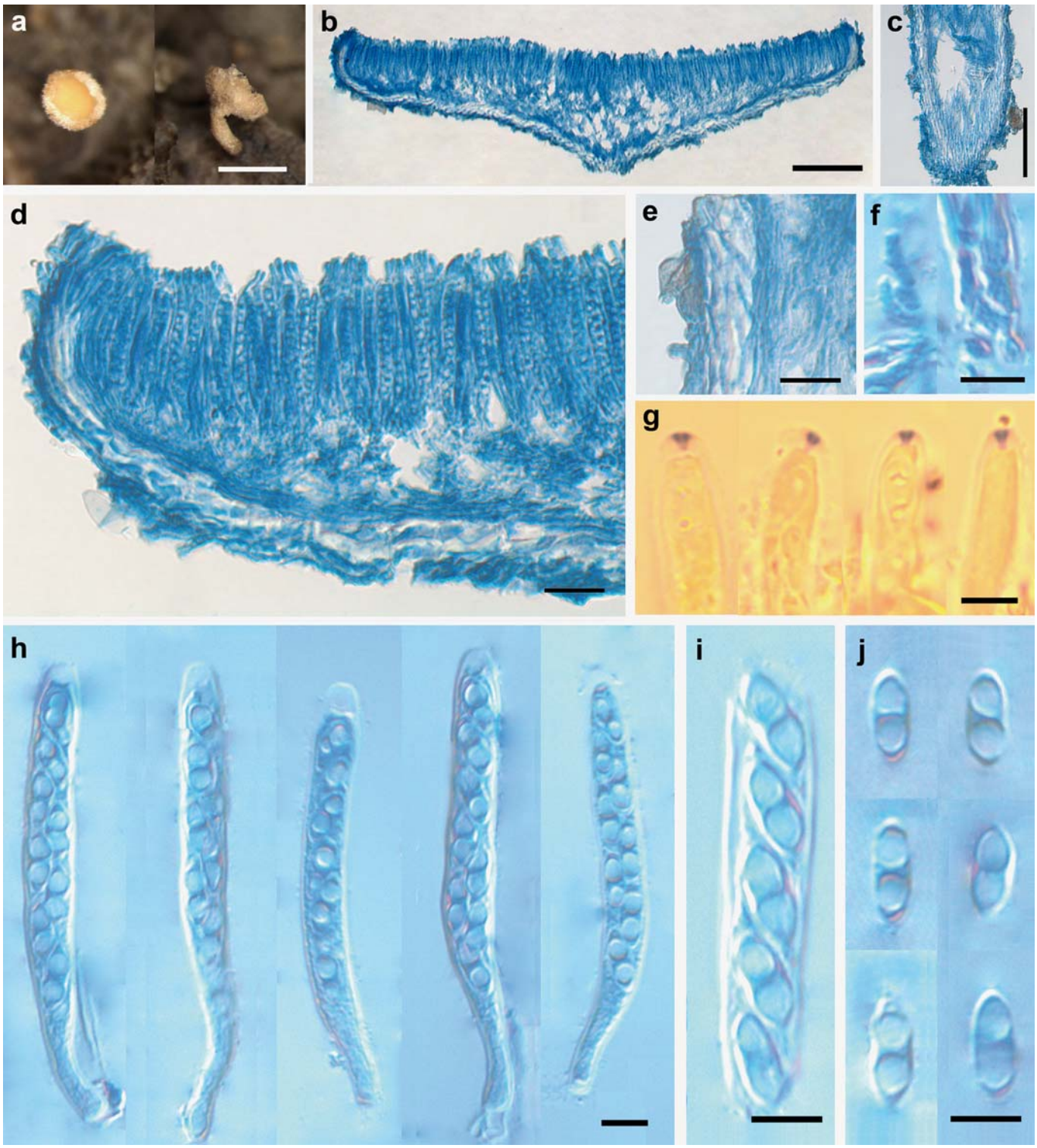

Fig. 6 – *Crocicreas albidum* HMAS 271412. a. Dry apothecia on natural substrate; b. Longitudinal section of apothecium; c. Longitudinal section of stipe; d. Excipular structure and hymenium; e. Structure in the middle of stipe; f. Croziers at ascus base; g. Ascus apical rings in IKI; h. Asci; i. Ascospores in the ascus; j. Ascospores. Scale bars: a = 0.5 mm, b–c = 100 µm, d–e = 20 µm, f–j = 5 µm.

Key to the known species of *Crocicreas* in China

1. Ascospores longer than 20 µm ..... ***C. korfii***
1. Ascospores shorter than 20 µm 2
2. Ascospores 2.2–3.5(–4) × 1.1–2.3 µm ..... ***C. minisporum***
2. Ascospores larger 3
3. Ascospores 3-septate ..... ***C. helios***
3. Ascospores 0–1-septate 4
4. Ascospores mostly shorter than 12 µm 5
4. Ascospores mostly longer than 12 µm 7
5. Asci arising from simple septa ..... ***C. cyathoideum***
5. Asci arising from croziers 6
6. Asci J-, ascospores fusoid, 6–10 × 2–2.2 µm ..... ***C. xinjiangensis***
6. Asci J+, ascospores ellipsoid, 6.5–8 × 2.5–3.3 µm ..... ***C. albidum***
7. Apothecia urceolate, margin collarette-like ..... ***C. nivale***
7. Apothecia not as above 8
8. Apothecial margin smooth; ectal excipulum of *textura prismatica* ..... ***C. boreosinicae***
8. Apothecial margin dentate to smooth; ectal excipulum of *textura intricata* ..... ***C. coronatum***

Notes: *Crocicreas cyathoideum* is the most commonly collected and widely distributed species of the genus (Carpenter, 1981). The fungus was first reported from China by Tai (1979) as *Phialea cyathoidea*.

Crocicreas helios (Penz. & Sacc.) S.E. Carp., *Brittonia*, 32 (2): 270 (1980).
≡ *Davincia helios* Penz. & Sacc., *Malpighia*, 15 (7-9): 215 (1902).

Specimen examined: China, Yunnan, Lüchun, alt. 1500 m, on herbaceous stems, 31.X.1999, W.Y. Zhuang & Z.H. Yu 3227 (HMAS 271413).

Notes: *Crocicreas helios* was first recorded from China by Wang (2002) based on two specimens collected from Taiwan Province. This is the only collection found from the mainland.

Crocicreas nivale (Rehm) S.E. Carp., *Brittonia*, 32 (2): 271 (1980).
≡ *Phialea nivalis* Rehm, *Annls Mycol*., 3 (5): 411 (1905).

Notes: *Crocicreas nivale* was known from China growing on decaying leaves of *Pandanus furcatus* Roxb. with asci 50–68 × 5–7.8 µm and 1-septate ascospores 10–14 × 2–3.8 µm (Whitton, 1999; Whitton *et al*., 2012). The voucher specimen HKU(M)4948 (IFRD213-007) collected in Hong Kong was not checked.

Excluded species

Crocicreas fuscum (W. Phillips & Harkn.) S.E. Carp., *Brittonia*, 32 (2): 270 (1980).
≡ *Belonidium fuscum* W. Phillips & Harkn., *Bull. Calif. Acad. Sci*., 1 (1): 23 (1884).

Notes: *Crocicreas fuscum* was recorded from China based on a specimen (HMAS 75882) collected from Beijing (Wang & Pei, 2001). Re-examination of the specimen revealed that it was mis-identified. The morphology of the fungus is distinctly different from the typical materials of *C. fuscum* (Carpenter, 1981), such as lacking dark brown hyphae in the ectal excipulum, ascus apical ring J+ instead of J-, ascospores non-septate instead of 3-septate, guttulate instead of eguttulate, and smaller in size [11.5–14.3 × 3.3–3.8 µm vs. (15–)18–20 × 3.0–3.5 µm]. The correct name for the fungus is *C. coronatum*. *Crocicreas fuscum* should be excluded from the Chinese fungus flora.

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References

Baral H.-O. 2009. — Iodine reaction in Ascomycetes: why is Lugol's solution superior to Melzer's reagent? http://www.gbif-mycology.de/HostedSites/Baral/IodineReaction.htm.

Baral H.-O., Galán R., Platas G. & Tena R. 2013. — *Phaeohelotium undulatum* comb. nov. and *Phaeoh. succineoguttulatum* sp. nov., two segregates of the *Discinella terrestris* aggregate found under *Eucalyptus* in Spain: taxonomy, molecular biology, ecology and distribution. *Mycosystema*, 32(3): 386-428.

Baral H.-O. & Krieglsteiner G.J. 1985. — Bausteine zu einer Askomyzeten-Flora der BR Deutschland: In Süddeutschland gefundene Inoperculate Diskomyzeten – mit taxonomischen, ökologischen und chorologischen Hinweisen. *Zeitschrift für Mykologie, Beiheft*, 6: 1-160.

Baral H.-O., Haelewaters D. & Partel K. 2015. — A new attempt to classify the families of the *Helotiales*. Poster. Second International Workshop on Ascomycete Systematics. Amsterdam, the Netherlands, 22-24 April 2015.

Carpenter S.E. 1981. — Monograph of *Crocicreas* (Ascomycetes, *Helotiales*, *Leotiaceae*). *Memoirs of the New York Botanical Garden*, 33: 1-290.

Chlebicka M. & Chlebicki A. 2007. — *Cyathicula brunneospora* and *Pirottaea atrofusca*, two new *Helotiales* from Tian Shan (Kazakhstan). *Mycotaxon*, 100: 37-50.

Kirk P., Cannon P., Minter D. & Stalpers J. 2008. — *Dictionary of the Fungi*. 10th ed. Wallingford, CABI, 784 p.

Korf R.P. & Carpenter S.E. 1974. — *Bisporella*, a generic name for *Helotium citrinum* and its allies, and the generic names *Calycella* and *Calycina*. *Mycotaxon*, 1: 51-64.

Lizoň P. & Korf R.P. 1995. — Taxonomy and nomenclature of *Bisporella claroflava* (*Helotiaceae*). *Mycotaxon*, 54: 471-478.

Raitviir A. & Shin H.-D. 2003. — New and interesting Inoperculate Discomycetes from Korea. *Mycotaxon*, 85: 331-340.

Tai F.L. 1979. — *Sylloge Fungorum Sinicorum*. Beijing, Science Press, 1527 p. (in Chinese).

Triebel D. & Baral H.-O. 1996. — Notes on the ascus types in *Crocicreas* (*Leotiales*, Ascomycetes) with a characterization of selected taxa. *Sendtnera*, 3: 199-218.

Wang Y.Z. 2002. — Two species of *Crocicreas* new to Taiwan. *Fungal Science*, 17(3-4): 83-86.

Wang Z. & Pei K.Q. 2001. — Notes on discomycetes in Dongling Mountains (Beijing). *Mycotaxon*, 79: 307-314.

Whitton S.R. 1999. — *Microfungi on Pandanaceae*. Ph.D Dissertation. Hong Kong, University of Hong Kong, 625 p.

Whitton S.R., McKenzie E.C. & Hyde K.D. 2012. — Teleomorphic Microfungi Associated with *Pandanaceae*. *In*: Whitton S.R., McKenzie E.C. & Hyde K.D. (eds). *Fungi Associated with Pandanaceae*. Fungal Diversity Research Series 21. Dordrecht, Springer: 23-124.

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