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A new species of *Craterium* (Myxomycetes, Physaraceae) growing on living grass and new records of the genus from China

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Abstract

A new species of *Craterium* (*C. subpurpurea*) collected in the Changbai Mountain National Nature Reserve, Jilin Province, northeastern China, is described. The fruiting bodies of *C. subpurpurea* are long cylindrical with distinct ridges, with large spinulose spores (8–10 µm diam.) as well as a persistent purplish pale peridium at the base of the sporotheca. A newly described species, *C. aureonuleatum*, has been documented in China for the first time, based on material collected from the Shennongjia National Nature Reserve, Hubei Province and the Gexigou National Nature Reserve, Sichuan Province. *Craterium aureonuleatum* is characterized by a yellowish pseudocolumella at the apex of the sporocarp and a persistent cup-like peridium when mature. Descriptions and scanning electron micrographs for these members of the genus *Craterium* are provided.

Keywords: taxonomy, SEM, phylogeny

Introduction

The Myxomycetes belong to the Eumycetozoa (Wijayawardene *et al.* 2020). The ontogenetic process reflects the evolutionary trend of organisms from single cell to multicellular, and plays an important role in the evolution of organisms (Martin & Alexopoulos 1969; Stephenson & Stempen 1994). *Craterium* was established by Trentepohl in 1797, and 17 species have been reported in the world (Kirk *et al.* 2008; Lado 2015-2019, Wijayawardene *et al.* 2020). Only eight species, *Craterium aureum* (Schumach.) Rostaf., *C. concinnum* Rex, *C. leucocephalum* (Pers. ex J.F. Gmel.) Ditmar, *C. microcarpum* H.Z. Li, Yu Li & Shuang L. Chen, *C. minutum* (Leers) Fr., *C. obovatum* Peck, *C. rubronodum* G. Lister and *C. corniculatum* B. Zhang & Yu Li, have been reported in China (Li & Li 1989; Li & Li 1993; Zhang & Li 2012, 2013). During an investigation into Myxomycetes in China from October 2017 to April 2019, specimens which could not be assigned to any known species were found on the living grass surface in the Changbai Mountain National Nature Reserve, Jilin Province, China. These specimens have been ascribed to a new species, which is easily distinguished from other known species of *Craterium*. *Craterium aureonuleatum* Nann.-Bremek. is reported from China for the first time.

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Materials and methods

Morphological studies. The fruiting bodies and microscopic structures were examined by light and scanning electron microscopes (Martin & Alexopoulos 1969, Zhang & Li 2012). Permanent slides were mounted in Hoyer's medium (Martin & Alexopoulos 1969), having been prepared according to Robbrecht (1974) by first dispersing capillitia in a drop of 94% alcohol and determining the colour after one minute. The colour terms are those used in the *Flora of British fungi: colour identification chart* (Anonymous 1969). Observations and measurements of the morphological characteristics were done using a stereomicroscope (20×) and an optical microscope (100×). Approximately ten sporocarps of each collection were measured, and about 20 spores and ornamentation measurements were made with an oil immersion objective. Sporocarps, capillitia and spores were measured using a Nikon dissecting microscope and Zeiss microscope, and photographs were taken with a Leica DM2000 microscope. For scanning electron microscopy (SEM) sporophores were attached to a holder, coated with gold using a Hitachi E-1010 sputter and examined with a Hitachi S-4800 scanning electron microscope at 10 kV located at the Engineering Research Center of Chinese Ministry of Education for Edible and Medicinal Fungi, Jilin Agricultural University, China. Specimens are deposited in the Herbarium of the Mycological Institute of Jilin Agricultural University (HMJAU).

Results

Taxonomy

Craterium subpurpurea B. Zhang & Yu Li, *sp. nov.* FIGURE **1, 2**
MycoBank: MB 830647

Sporophores in small groups, shortly stalked or nearly sessile, 0.75–1 mm tall. Sporotheca cylindrical or subcylindrical, 0.2–0.3 mm in diam.. Hypothallus conspicuous, membranous, pale yellow, veined with ribs that radiate from the sporocarp base. Stalk short, strongly ribbed, yellowish brown to brown, yellowish brown by transmitted light. Lid irregular cracking, pale than the cup, usually with a pale calcareous deposit, reddish pale by transmitted light, with pale dehiscence lines and circular split area. Peridium thick, double, outer cartilaginous, containing small lime. Inner membranous, transparent, colourless. Pseudocolumella purplish white, usually at the top of sporocarp. Capillitium rather dense, lime nodes rounded or angular, small, pale yellowish brown by transmitted light, 10×13–15×20 μm. Spores free, fuscous black in mass, dark brown by transmitted light, subglobose, 8–10 μm diam., densely spinulose spores.

Holotype:—CHINA. Jilin Province: Changbai Mountain National Nature Reserve, on living grass, 7 August 2017, Zhang Bo, 20170803026 (Holotype, HMJAU-M1553); 23 July 2018, Zhang Bo, 20180923001 (Isotype, HMJAU-M1554).

Etymology:—subpurpurea (Latin), referring to referring to base color of sporocarp.

Distribution:—Known only from the type locality, Changbai Mountain National Nature Reserve.

Comments:—Among the 17 accepted *Craterium* species, *C. leucocephalum* (Pers. ex J.F. Gmel.) Ditmar and *C. aureonucleatum* Nann.-Bremek. are comparatively similar to *C. subpurpurea* in having stalked sporocarps and spinulose spores (7–10 μm in diam). *Craterium aureomagnum* has larger and longer sporocarps (about 0.7–1.5 mm tall), a double peridium and darker and more prominently warted spores (about 10–12 μm in diam.) (Hooff & Nannenga-Bremekamp 1996). *Craterium leucocephalum* differs in its turbinate or cylindrical sporocarps (about 1–1.5 mm tall) which are lemon-yellow, fading to almost white.

Craterium aureomagnum Hooff & Nann.-Bremek., Proc. Kon. Ned. Akad. Wetensch. 99(1-2):46 (1996) Figure 3

Sporocarps short-stalked or sessile, 0.5-0.7 mm tall. Sporothecae subglobose or fusiform, 0.4-0.5 mm diam., orange-brown to brown. Hypothallus membranous, transparent, discoid. Stalk 0.3 mm long, shallow grooved, dark orange to brown. Peridium two layers, the inner layer membranous, the outer layer thicker, orange below, yellow above, the upper part with white calcareous granules, the apex forming a convex lid, the cup rim torn and irregular. Pseudocolumella yellow, at base of sporocarp, persistent. Capillitium netting with small meshes, angular, often branched, the nodes

sometimes contain yellow crystalline discs. Spore-mass dark brown. Spores 9-10 µm diam., verruculose or faint warts, dark brown in transmitted light.

Specimens examined:—CHINA. Hubei Province: Shennongjia National Nature Reserve, on surface of a dead log and leaves, 22 July 2013, Zhang Bo 2016010901 (HMJAU10523). CHINA, Sichuan Province: Gexigou National Nature Reserve, on bark of a dead log, 13 September 2009, Li Ming 2015111805 (HMJAU10524). CHINA, Sichuan Province: Liangshan Yi Autonomous Prefecture, Mianning County, Lingshan Temple, 12 July 2013, Zhang Bo 2013122601 (HMJAU10525).

Comments:—*Crateriυm aureomagnum* has been recorded in the Netherlands, Japan and France. The Sichuan and Hebei specimens have smaller spores (9–11 µm in diam.) than the type specimen (10–12 µm in diam.). The Sichuan, Hebei and type specimen all have a similar habitat of dead logs and faintly warted spores.

FIGURE 1. ***Crateriυm subpurpurea*** (holotype): A,B. Fruiting bodies, C. Stalk, part of sporocarp and spores, D. Spores and Capillitia.

Key to ***Crateriυm*** species

1. Sporophores dehiscing by a distinct lid....2
1. Sporophores not dehiscing by a distinct lid....8
2. Spores reticulate ....*C. retisporum*
2. Spores spinulose and warted 3
3. Spores less than 10 µm in diam.....*4*
3. Spores more than 10 µm in diam....6
4. Lid dome-shaped, fragmenting by preformed lines at dehiscence 5
4. Lid convex or fat, not veined, remaining as a whole at dehiscence 7
5. Sporocarps 0.15–0.41 mm high. Spores 8–10 µm diam....*C. microcarpum*
5. Sporocarps 0.6–1 mm high. Spores 7–9 µm diam....*C. reticulatum*
6. Sporocarps small, 0.5–0.8 mm high. Spores 9–10 µm diam.... *C. concinnum*
6. Sporocarps higher, up to 1.5 mm. Spores 8–10 µm diam....*C. minutum*
7. Spores 10–12 µm diam., with spines 1µm tall ....*C. rubronodum*
7. Spores 13–15 µm diam., with groups of confluent spores ....*C. costatum*
8. Sporophores obconic, leaving cup-shaped after dehiscence 9
8. Sporophores obovoid, turbinate, corniculate, dehiscence irregular....11
9. Sporocarps usually stalked. Spores 7–10 µm in diam.....10

9. Sporocarps sessile or shortly stalked. Spores 9–10 µm in diam ..... *C. aureonucleatum*
10. Pseudocolumella white ..... *C. leucocephalum*
10. Pseudocolumella purplish white ..... *C. subpurpurea*
11. Sporocarps yellow 12
11. Sporocarps bright pink, purplish pink, red brown 14
12. Sporocarps stalked ..... *C. aureum*
12. Sporocarps sessile or very short-stalked 13
13. Sporocarps subcylindric. Spores 10–12 µm in diam ..... *C. aureomagnum*
13. Sporocarps corniculate. Spores 8–14 µm in diam ..... *C. corniculata*
14. Sporocarps bright pink, purplish pink.. ..... *C. paraguayense*
14. Sporocarps red brown, purplish brown, dark brown to black. 15
15. Spores warted, less than 13 µm in diam ..... *C. atrolucens*
15. Spores coarsely warted, subreticulate or reticulate, more than 13µm in diam 16
16. Spores with dark prominent warted ..... *C.obovatum*
16. Spores subreticulate or reticulate 17
17. Spores marked with an incomplete net of broad spines fused into short ridges, 14–17 µm in diam. ..... *C. dictyosporum*
17. Spores loosely reticulate by ridges about 1µm high, 13–16 µm in diam ..... *C. muscorum*

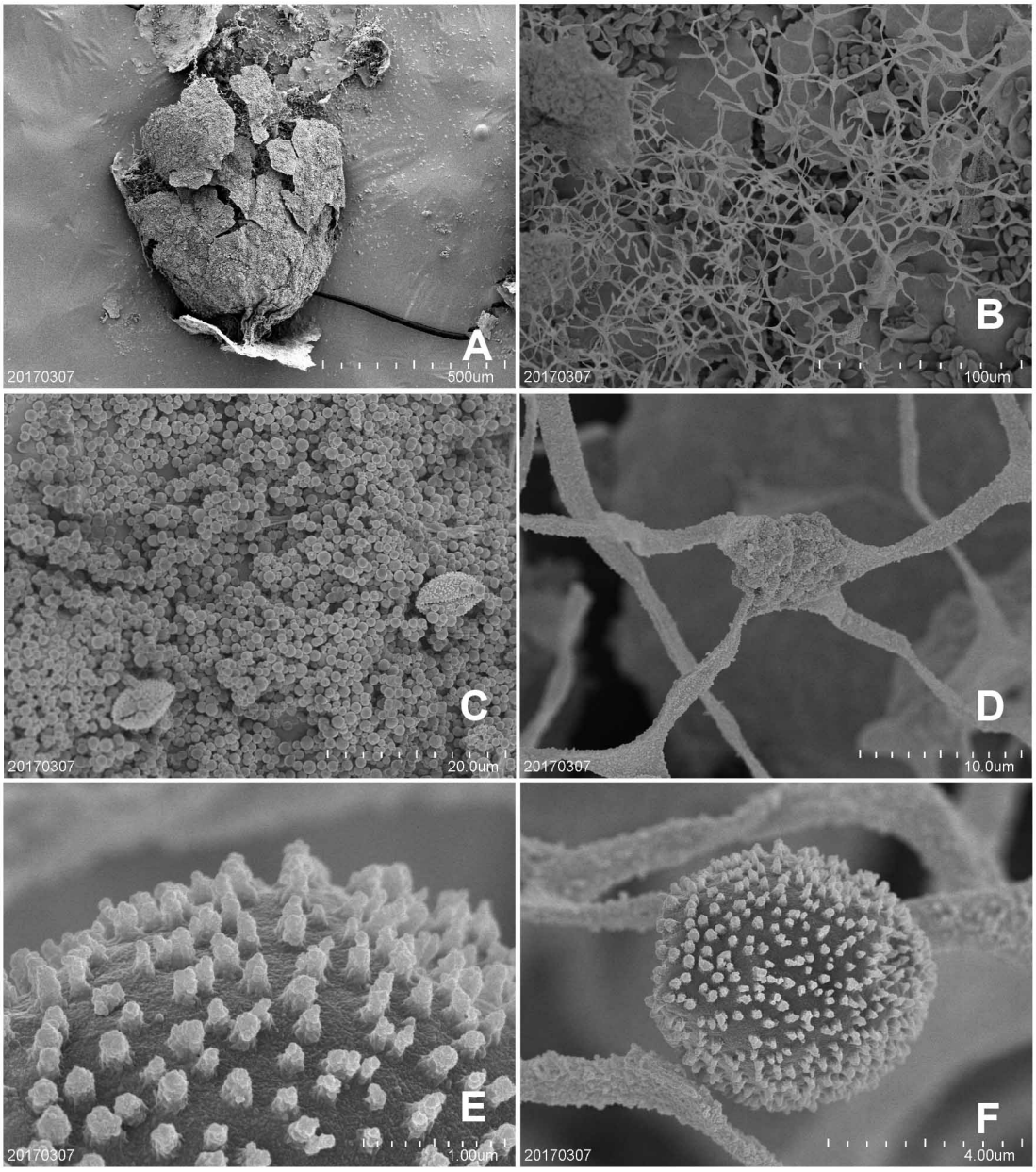

FIGURE 2. ***Craterium subpurpurea*** (holotype): A. Sporocarp. B. Part of capillitia and spores. C. Surface of peridium D. Lime nodes rounded or angular. E, F. Spore marked with spinulose.

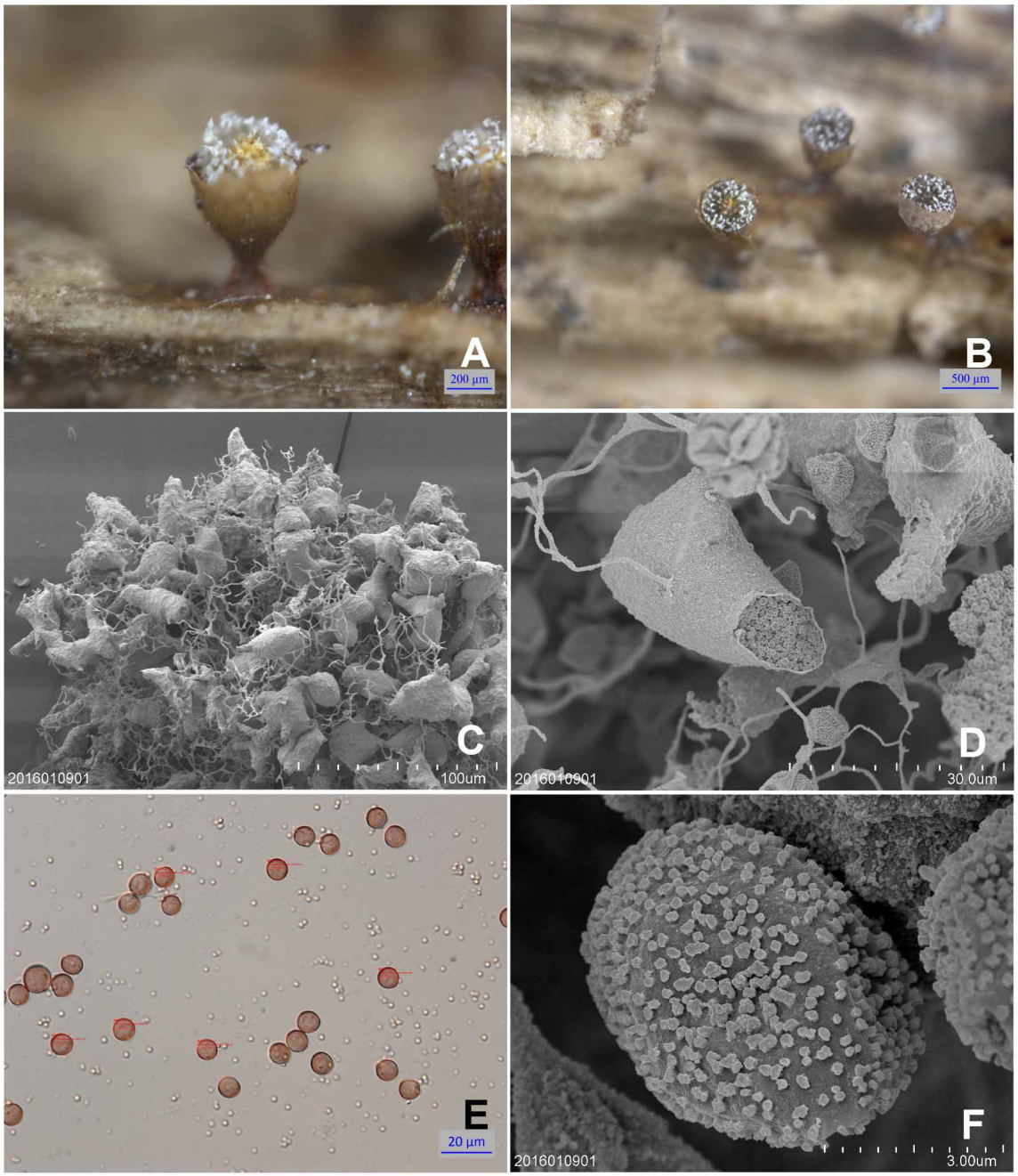

FIGURE 3. ***Craterium aureomagnum***: A, B. Sporocarps. C, D. Part of capillitia. E. Spores in transmitted light. F. Spores under SEM with faint warts or verruculose.

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