

Two new records of *Jahnula* (*Aliquandostipitaceae*) from freshwater habitats in Egypt

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Two species of lignicolous freshwater ascomycetes, *Jahnula bipileata* and *J. dianchia*, are recorded for the first time from Egypt, growing in submerged decaying wood samples from the River Nile and irrigation canals in the Sohag Governorate. Prior to this study, *Jahnula bipileata* had only been found in the United States and Iraq, whereas *J. dianchia* had only been recorded in China. The two species are described, illustrated and compared with the existing collections herein. A key to *Jahnula* species recorded in Egypt is provided.

Key words: *Dothideomycetes*, freshwater fungi, *Jahnulales*, lignicolous fungi, River Nile.

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Bakhit M.S. (2022): Nové nálezy dvou druhů rodu *Jahnula* (*Aliquandostipitaceae*) ze sladkovodních biotopů v Egyptě. – Czech Mycol. 74(1): 67–75.

Dva druhy lignikolních sladkovodních vřekatých hub, *Jahnula bipileata* a *J. dianchia*, jsou poprvé zaznamenány z Egypta ve vzorcích ponořeného tlejícího dřeva z Nilu a zavlažovacích kanálů v guvernorátu Sohag. *Jahnula bipileata* byla dosud nalezena pouze ve Spojených státech a Iráku, zatímco *J. dianchia* byla známa pouze z Číny. Článek přináší popis obou druhů s obrazovým doprovodem a srovnání s dosavadními sběry. Práci doplňuje souhrnný klíč k určení egyptských druhů rodu *Jahnula*.

INTRODUCTION

The largest genus in *Jahnulales*, *Jahnula*, typified by *J. aquatica* (Kirschst.) Kirschst., was proposed by Kirschstein (1936). Dong et al. (2020) revised 21 *Jahnula* species and accepted three of them, namely *J. aquatica*, *J. granulosa* K.D. Hyde et S.W. Wong and *J. rostrata* Raja et Shearer in *Jahnula* sensu stricto. The three species form a well-supported clade sharing the following morphological features: dark ascomata with basal appendages, and brown, one-septate ascospores with widened apical cells (Hawksworth 1984, Hyde et Wong 1999, Raja et

Shearer 2006). Hawksworth (1984) considered the ascomatal wall structure, consisting of massive pseudoparenchymatous cells to 30 µm wide, to be the most remarkable diagnostic feature of *Jahnula*.

Dong et al. (2020) introduced two new genera, *Neojahnula* W. Dong, H. Zhang et K.D. Hyde and *Pseudojahnula* W. Dong, H. Zhang et K.D. Hyde, to accommodate *Jahnula australiensis* K.D. Hyde and *J. potamophila* K.D. Hyde et S.W. Wong. They also transferred seven species of *Jahnula* which are phylogenetically distant from the type species to *Ascagilis* K.D. Hyde. Nine species, i.e. *J. apiospora*, *J. appendiculata*, *J. bipileata*, *J. dianchia*, *J. morakotii*, *J. poonythii*, *J. purpurea*, *J. sangamonensis* and *J. systyla*, were retained in *Jahnula* sensu lato for further study (Dong et al. 2020). Based on its fusiform, brown to blackish chlamydospores developed in culture, Sivichai et al. (2011) concluded that *Xylomyces chlamydosporus* Goos, R.D. Brooks et Lamore is an asexual form of *Jahnula aquatica*. Molecular evidence, on the other hand, has contradicted this finding (Suetrong et al. 2011, Dong et al. 2020).

Jahnula species have been recorded from many countries: Australia, Canada, China, Czech Republic, Egypt, France, Germany, Iraq, Malaysia, Martinique, Mauritius, Mexico, Peru, South Africa, Thailand and the USA (Kirschstein 1936, Hawksworth 1984, Ho 1998, Hyde et Wong 1999, Cai et al. 2002, Pinruan et al. 2002, Luo et al. 2004, Gonzalez et Chavarria 2005, Raja et Shearer 2006, Raja et al. 2008, 2009, Al-Saadoon et Al-Dossary 2010, Fournier et al. 2010, Sivichai et Boonyuen 2010, Sivichai et al. 2011, Suetrong et al. 2011, Abdel-Raheem et al. 2015, Fournier et al. 2015, Shearer et al. 2015, Abdel-Aziz 2016, Huang et al. 2018, Hongsanan et al. 2020, Mičoch 2020). The present twelve species of *Jahnula* have all been identified from submerged woody substrates in freshwater environments.

Four species of *Jahnula*, i.e. *J. aquatica*, *J. granulosa*, *J. poonythii* K.D. Hyde et S.W. Wong and *J. sangamonensis* Shearer et Raja, have been reported from freshwater habitats in Egypt (Abdel-Raheem et al. 2015, Abdel-Aziz 2016). During an ongoing survey of freshwater fungi in Egypt, two species, *Jahnula bipileata* Raja et Shearer and *J. dianchia* S.K. Huang et K.D. Hyde, were discovered for the first time from Egypt. These two species are described and illustrated in this paper.

MATERIAL AND METHODS

Decaying submerged wood samples were collected randomly from different sites in the River Nile and irrigation canals in Sohag Governorate, Egypt in the period from November 2018 to February 2020. The studied area belongs to the arid region of North Africa, which is generally characterised by hot summers and mild winters with low rainfall. The riparian vegetation of the riverbank in Sohag Governorate consists mainly of *Phragmites australis*, *Arundo donax* and *Eucalyptus* spp., *Vachellia nilotica*, *Salix mucronata*, *Ziziphus spina-christi* and dwarf shrubs such as *Pluchea dioscoridis* and *Alhagi graecorum*.

Sample collection, incubation and examination were performed as described in Bakhit (2021). Ascomatal squash obtained from the fresh specimen was mounted in distilled water for all measurements and photography. Microscopic characters were studied with an Olympus BX51 bright field microscope equipped with a DIC (differential interference contrast) system. Micrographs were obtained using the Optika view version 7.3.1.7 (Optika, Ponteranica, Italy) digital imaging system. Herbarium vouchers of the recorded species were prepared by drying samples bearing the fungus at 60 °C for 24 h. These herbarium specimens and permanent slides are deposited at Sohag University Microbial Culture Collection, Sohag, Egypt (SUMCC).

RESULTS AND DISCUSSION

Jahnula bipileata Raja et Shearer

Fig. 1

Saprobic on decaying submerged wood. **Sexual morph:** Ascomata 400–420 × 195–210 µm (mean = 408 × 205 µm, n = 6), subglobose to obpyriform, superficial with partially immersed base, black, solitary, ostiolate, attached to the substrate by brown, broad (9.5–18 µm), septate, unbranched hyphae. Neck 67–118 × 60–78 µm, pale to dark brown. Ascomatal wall membranous, 25–36 µm thick, 3–5-layered, composed of outer brown to inner hyaline cells, forming a *textura angularis*. Pseudoparaphyses 2–2.5 µm wide, hyaline, filiform, septate and branched. Asci 125–150 × 17.5–22 µm (mean = 139.2 × 19.3 µm, n = 23), cylindrical, pedicellate, eight-spored, bitunicate, fissitunicate, thin-walled, rounded at apex, with an apical chamber. Ascospores 22.5–33 × 11–13.5 µm (mean = 25.8 × 12.5 µm, Q = 1.6–2.5, Q_{mean} = 2.1, n = 48), overlapping uniseriate, dark brown, one-septate, widely ellipsoidal to fusiform, somewhat constricted at the septum, upper cell slightly broader, rough-walled in an irregularly striation pattern, with hyaline caps of up to 2 × 2–3 µm in size at both apices. **Asexual morph:** Unknown.

Specimen examined

Egypt. Sohag Governorate, City of El-Maragha, River Nile (26°44'06.7" N, 31°35'02.3" E), on decaying submerged wood, 16 August 2019, leg. et det. M.S. Bakhit (SUMCC H-19003).

Known distribution. USA (Raja et Shearer 2006), Iraq (Al-Saadoon et Al-Dossary 2010), Egypt (this study).

Notes. *Jahnula bipileata* was described by Raja et Shearer (2006) from submerged, decorticated wood from freshwater habitats in Florida. Since then, it has only been found once on a dead date palm leaf in a brackish habitat in Iraq (Al-Saadoon et Al-Dossary 2010). This species differs from other taxa in *Jahnula* by having irregularly striated rough-walled ascospores with a hyaline cap at both apices. It differs from the most similar species *J. aquatica* and *J. granulosa* in having shorter ascospores (25–30 µm vs 30–40 µm in *J. aquatica* and 26–37.5 in *J. granulosa*) (Hyde et Wong 1999, Raja et Shearer 2006). *Jahnula granulosa* has ascospores with a thin mucilaginous sheath, a feature not observed in *J. bipileata*.

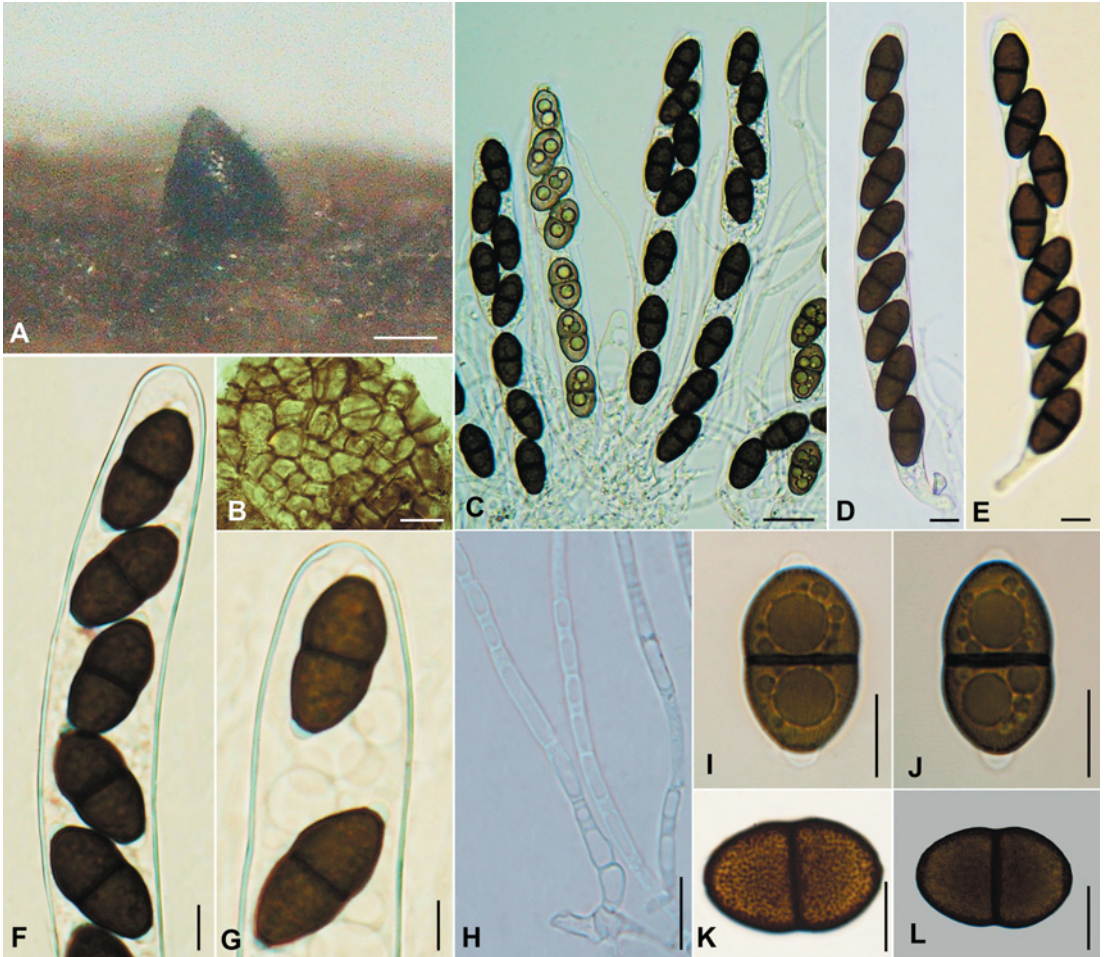


Fig. 1. *Jahnula bipileata* (SUMCC H-19003). **A** – ascoma on substrate; **B** – exterior view of the ascomatal wall; **C** – ascomatal squash showing asci at different stages of maturity; **D–F** – asci; **G** – ascus apex; **H** – pseudoparaphyses; **I–L** – ascospores in different views. Bars = 100 μm (A), 30 μm (B, C), 10 μm (D–L). Photos M.S. Bakhit.

Ascospores of *J. sangamonensis* differ from those of *J. bipileata* in having rounded apices without a hyaline cap (Raja et Shearer 2006). The collection from Egypt has slightly shorter and wider asci (125–150 \times 17.5–22 μm vs. 170–220 \times 10–17 μm in type collection) and wider ascospores (11–13.5 μm vs. 9–10 μm). In all other aspects it is morphologically similar to the type collection by Raja et Shearer (2006) (Tab. 1).

Tab. 1. Comparison of ascoma, ascus and ascospore dimensions of *Jahnula bipileata* and *J. dianchia* with previously described collections.

Species name	Herbarium no.	Locality	Ascomata (μm)	Asci (μm)	Ascospores (μm)	Reference
<i>J. bipileata</i>	ILL F49-1	Florida, USA	395–400 \times 200–205	170–220 \times 10–17	25–30 \times 9–10	Raja et Shearer 2006
<i>J. bipileata</i>	–	Basrah, Iraq	380–390 \times 175–190	170–200 \times 9–15	20–26 \times 8–10	Al-Saadon et Al-Dossary 2010
<i>J. bipileata</i>	SUMCC H-19003	Sohag, Egypt	400–420 \times 195–210	125–150 \times 17.5–22	22.5–33 \times 11–13.5	This study
<i>J. dianchia</i>	KUN-HKAS 96327, MFLU 17-0693	Yunnan Province, China	307–418 \times 248–374	198–238 \times 16–20	24–32 \times 10–21	Huang et al. 2018
<i>J. dianchia</i>	KUN-HKAS 92632, MFLUCC 16-0983	Yunnan Province, China	285–390 \times 250–350	150–170 \times 15–17	27–29 \times 11–13	Hongsanan et al. 2020
<i>J. dianchia</i>	SUMCC H-18005	Sohag, Egypt	283–442 \times 298–342	125–160 \times 14–22	21–28 \times 10–14	This study

Jahnula dianchia S.K. Huang et K.D. Hyde

Fig. 2

Saprobic on decaying submerged wood. Sexual morph: Ascomata 283–442 × 298–342 µm (mean = 386 × 322 µm, n = 6), subglobose to obpyriform, superficial to semi-immersed, solitary, dark brown to black, membranous, papillate, ostiolate, attached to the substrate by broad (9–16 µm wide), brown, branched, septate, superficial hyphae. Ascromatal wall 30–60 µm thick, membranous, with outer brown to inner hyaline *textura angularis* cells. Pseudoparaphyses 2.5–3.5 µm wide, septate, filamentous, hyaline. Asci 125–160 × 14–22 µm (mean = 144.5 × 20.1 µm, n = 24), cylindrical, rounded at apex, pedicellate, with an ocular chamber, eight-spored, bitunicate, fissitunicate, thin-walled. Ascospores 21–28 × 10–14 µm (mean = 23.4 × 11.2 µm, Q = 1.7–2.7, Q_{mean} = 2.07, n = 41), overlapping uniseriate, brown to dark brown, smooth, one-septate, oval to ellipsoidal, slightly curved, apiculate, with a mammiform apex, rounded at lower end. Asexual morph: Unknown.

Specimen examined

Egypt. Sohag Governorate, City of El-Maragha, irrigation canal (26°41'43.0" N, 31°36'16.0" E), on decaying submerged wood, 16 November 2018, leg. et det. M.S. Bakhit (SUMCC H-18005).

Known distribution. China (Huang et al. 2018, Hongsanan et al. 2020), Egypt (this study).

Notes. *Jahnula dianchia* was described from decaying submerged wood from Lake Dianchi in Yunnan, China (Huang et al. 2018) and re-collected from submerged wood in freshwater habitats in Northwestern Yunnan Province, China (Hongsanan et al. 2020). This species differs from other species in the genus in ascospore morphology, such as dark brown ascospores with mammiform apices. *Jahnula dianchia* collected in Egypt has overlapping uniseriate, slightly curved, oval to ellipsoidal ascospores with a mammiform apex, but has shorter asci (125–160 × 14–22 µm vs 198–238 × 16–20 µm in the original description, see Tab. 1). Ascomata in the collection from Egypt are attached to the substrate by broad, brown, branched, septate hyphae, while the collections of Huang et al. (2018) and Hongsanan et al. (2020) lack those thick hyphae.

Key to *Jahnula* species recorded in Egypt based on the sexual morph

In the genus *Jahnula*, twelve species have been accepted, all of which were described from wood or decorticated wood in freshwater environments (Hyde et Wong 1999, Raja et Shearer 2006, Campbell et al. 2007, Huang et al. 2018). *Jahnula bipileata* and *J. dianchia* are newly reported from Egypt, and four species of *Jahnula* (*J. aquatica*, *J. granulosa*, *J. poonythii* and *J. sangamonensis*) have been recorded earlier from freshwater habitats in Egypt (Abdel-Raheem et

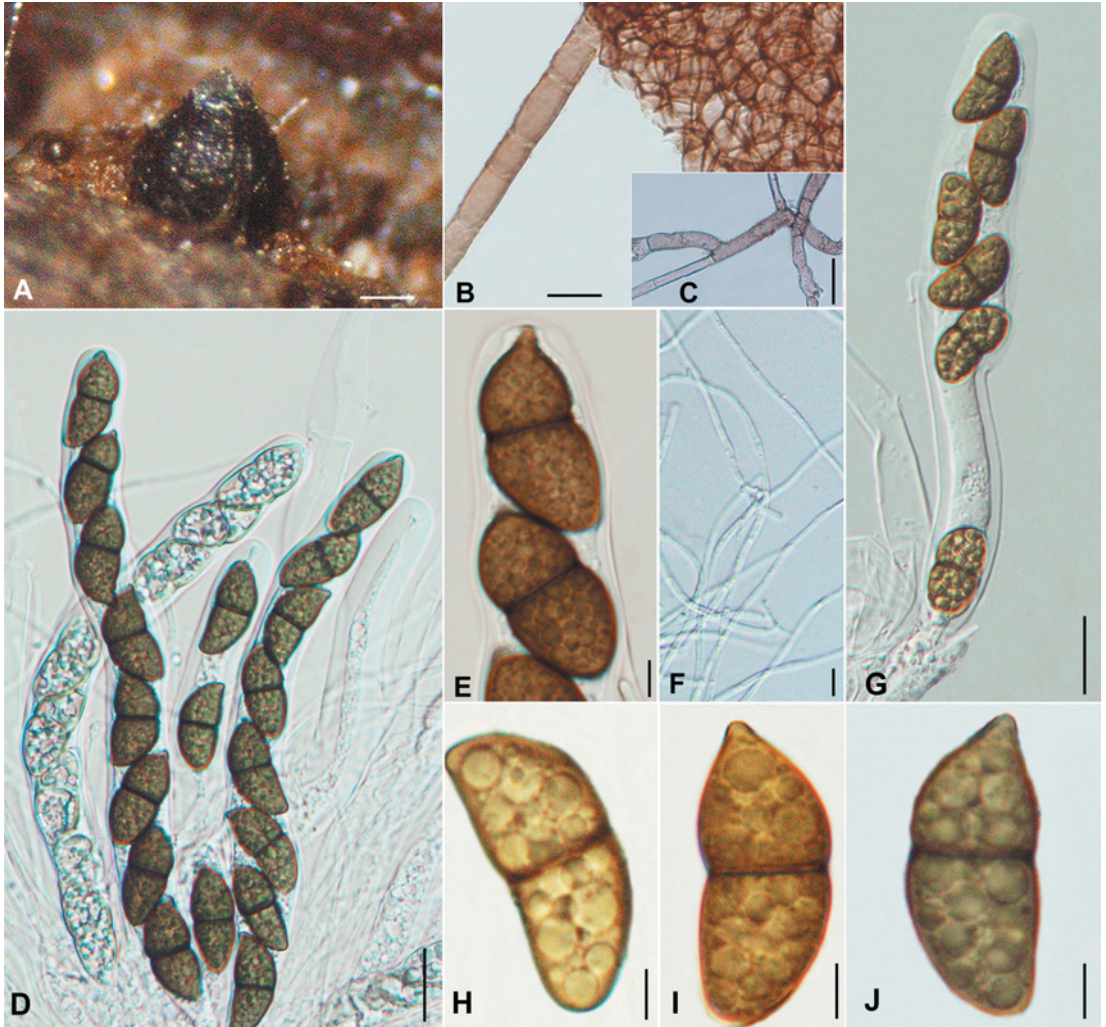


Fig. 2. *Jahnula dianchia* (SUMCC H-18005). **A** – ascoma on substrate; **B** – exterior view of the ascomatal wall and thick hypha; **C** – branched thick hyphae; **D** – ascomatal squash showing asci at different stages of maturity; **E** – ascus apex with ocular chamber; **F** – pseudoparaphyses; **G** – fissitunicate ascus; **H–J** – ascospores. Bars = 100 μm (A), 20 μm (B–D, G), 5 μm (E, F, H–J). Photos M.S. Bakhit.

al. 2015, Abdel-Aziz 2016). A dichotomous key based on the sexual morph is provided here for identification of Egyptian *Jahnula* species.

1	Ascospores with sheath or caps	2
1'	Ascospores lacking a sheath or caps	3
2	Ascospores rough-walled in an irregularly striated pattern, 22.5–33 × 9–13.5 µm, with hyaline caps at both apices ³	<i>J. bipileata</i>
2'	Ascospores granular-walled, 26–37.5 × 15–18 µm, surrounded by mucilaginous sheath ²	<i>J. granulosa</i>
3	Ascospores with mammiform apex ⁴	<i>J. dianchia</i>
3'	Ascospores without mammiform apex	4
4	Ascospores longer than 30 µm ¹	<i>J. aquatica</i>
4'	Ascospores shorter than 30 µm	5
5	Ascospores fusiform or oblong, with tapering apices, distinctly verruculose ²	<i>J. poonythii</i>
5'	Ascospores broadly ellipsoidal, rounded at apices, smooth or minutely verruculose ³	<i>J. sangamonensis</i>

The key characters are based on personal observations and the literature sources

¹ Hawksworth (1984), ² Hyde et Wong (1999), ³ Raja et Shearer (2006), ⁴ Huang et al. (2018).

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