

Gonatophragmium lichenophilum sp. nov. – a new lichenicolous hyphomycete from Austria

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Abstract. The new lichenicolous hyphomycete species *Gonatophragmium lichenophilum*, found on *Xanthoria parietina* in Austria, is described, illustrated, discussed and compared with other species of *Gonatophragmium*. A key is given to all recognised species of this genus.

Key words: *Ascomycota*, asexual morph, Austria, *Gonatophragmium*, lichen-inhabiting, lichenicolous fungi, taxonomic novelty

Introduction

Lichens provide a special varied ecological niche for lichenicolous fungi. Lichen-inhabiting fungi are diverse and cover a wide range of fungi mainly belonging to the *Ascomycota*, but they are still inadequately examined in most parts of the world, even in many parts of Europe. The first author has been engaged in the exploration of lichenicolous species in Austria for some 20 years and currently deals with the survey of Upper Austrian lichenicolous fungi. During the course of field trips, various new and interesting collections of hyphomycetes growing on lichens have been encountered. One of them could readily be identified as a species of *Gonatophragmium* Deighton (in Cjep & Deighton 1969), but attempts to assign it to one of the existing species failed, which suggests that a new undescribed species is involved.

The first author has put special emphasis on the diversity of lichenicolous fungi growing on the lichen *Xanthoria parietina* (Etayo & Berger 2009), which has become the most frequent foliose lichen in extra alpine areas of Upper Austria, due to air pollution with rising levels of NO_x in last decades. But despite regular search this conspicuous hyphomycete had

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never been observed before, in contrast to some ten others on the same host lichen (private dataset). The material had been collected on a twig of a cut tree, along with some other xanthoriicolous fungi, such as *Arthonia molendoi* (Heufler ex Frauenf.) R. Sant., *Polycoccum slaptoniense* D. Hawksw., *Phoma physciicola* Keissl., *Pyrenochaeta xanthoriae* Diederich, *Lichenonium xanthoriae* M.S. Christ., and *Xanthoriicola physciae* (Kalchb.) D. Hawksw.

Material and methods

Standard light microscopy (Olympus BX50) has been used to examine the colonies of the lichenicolous hyphomycete (unstained samples mounted in distilled water, oil immersion, $\times 1000$ magnification). The given size ranges of conidiophores, conidia and other structures are based on 30 measurements, with the extremes given in parentheses. Digital pictures were made by B. Heuchert with a ZEISS Axioskop 2 with ZEISS AxioCam HR and occasionally optimised with the software ZEISS AxioVision. Freehand drawings were carried out on the basis of microscopic preparations by U. Braun.

Results and discussion

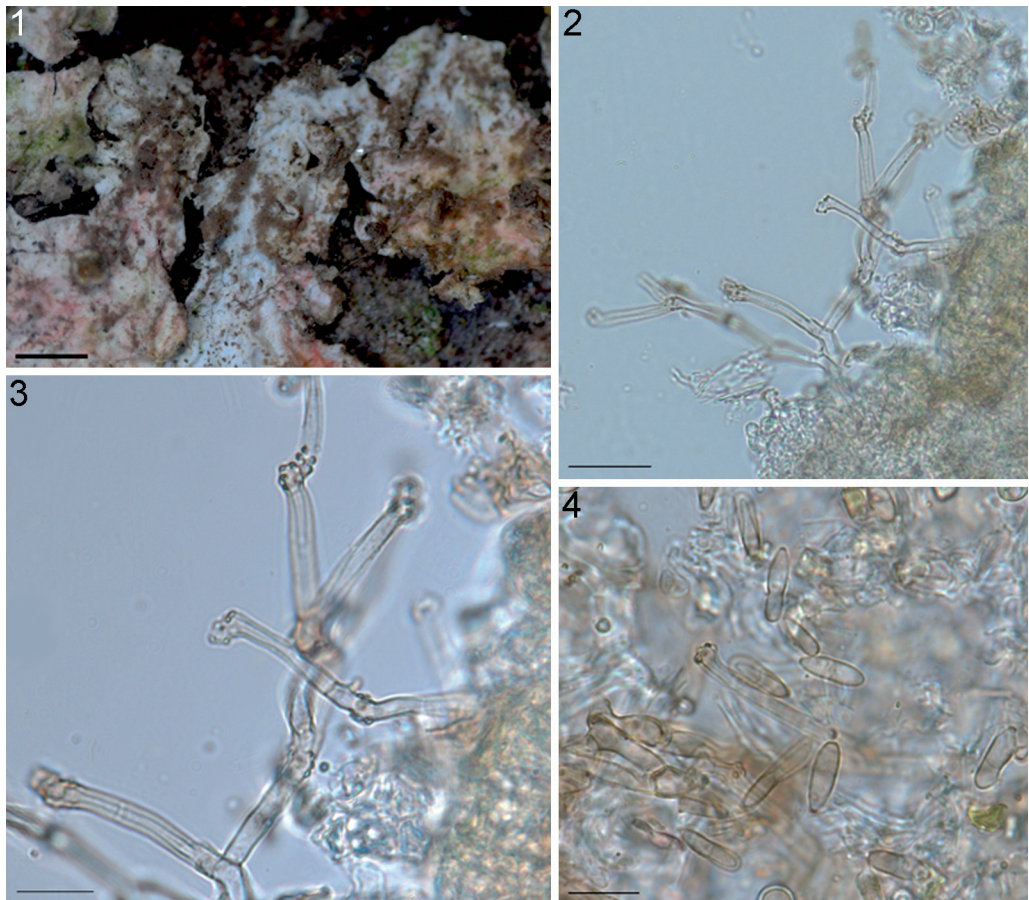
Gonatophragmium lichenophilum F. Berger & U. Braun, sp. nov.
MYCOBANK MB 812565

Figs 1–5

Gonatophragmium obscuro simile sed conidiophoris longioribus, ad 120 μm , conidiis ellipsoideis-ovoideis, subcylindraceis, (7–)9–15(–17) \times (2.5–)3–4(–4.5) μm , apice obtuso, rotundato.

Type: Austria, Oberösterreich, Donautal, Hofkirchen im Mühlkreis, Niederranna, 48°28'16"N, 13°46'45"E, 290 m alt., on living thalli of *Xanthoria parietina*, on twigs of *Juglans regia*, 23 Mar 2015, F. Berger 29059 (HAL 2686 F, holotype).

Colonies on discoloured (bleached) parts of host thalli, occasionally also on apothecia, punctiform to effuse, loose to moderately dense, velvety, pale to medium brown or cinnamon-brown. Mycelium immersed. Stromata lacking. Conidiophores arising from swollen hyphal cells, erect to decumbent, once to usually several times dichotomously to irregularly branched in acute to right angles, forming complex, branched structures, ramifications on different levels (not confined to the upper part of conidiophores), 50–120 μm long, main axis and branches 2–4(–5) μm wide, subhyaline, to pale or medium brown, thin-walled, smooth; conidiogenous cells integrated, terminal or/and intercalary and pleurogenous, 10–30 μm long, subcylindrical to somewhat enlarged towards the tip, occasionally slightly attenuated, 4–7.5 μm wide when inflated, straight, somewhat curved or somewhat geniculate-sinuuous, rarely short furcate, with numerous conspicuous conidiogenous loci, to about 35 per conidiogenous cell, 0.5–1 μm diam., in front view visible as minute circles, not or only slightly darkened, barely thickened, somewhat refractive. Conidia solitary, ellipsoid, ovoid to short subcylindrical, straight or occasionally slightly curved, (7–)9–15(–17) \times (2.5–)3–4(–4.5) μm , length/breadth ratio 2.3–4, (0–)1(–2)-septate, in 1-septate conidia septum more or less median, not or only slightly constricted at the septa, subhyaline to pale yellowish, greenish, olivaceous or very pale olivaceous-brown, thin-walled, smooth, apex



Figs 1–4. *Gonatophragmium lichenophilum* (HAL 2686 F, holotype). 1. Macroscopic overview of colonies. 2. Branched conidiophores. 3. Geniculate-sinuuous conidiogenous cells with numerous conspicuous conidiogenous loci. 4. Conidia with refractive to slightly darkened hila. Scale bars: 1 = 100 μm , 2 = 20 μm , 3, 4 = 10 μm (photos: B. Heuchert)

obtuse, broadly rounded, base short obconically truncate, 0.7–1 μm wide, hila unthickened or almost so, but conspicuous by being refractive or slightly darkened.

Deighton, in Cjep & Deighton (1969), described the genus *Gonatophragmium* with *G. mori* (Sawada) Deighton as type species, a combination based on *Spondylocladium mori* Sawada. Takahashi & Teramine (1986) considered *Acrospermum viticola* Ikata & Hitomi as the sexual morph of this species. This connection seems to be possible, although not proven by molecular examinations, since Crous et al. (2014) found *Acrospermum adeanum* Höhn. as closest relative of *Gonatophragmium triuniae* Crous & Summerell, based on a comparison of LSU sequences with 95% similarity. However, it is not yet settled if *Acrospermum* Tode and *Gonatophragmium* are, indeed, congeneric since the phylogenetic affinity of the type

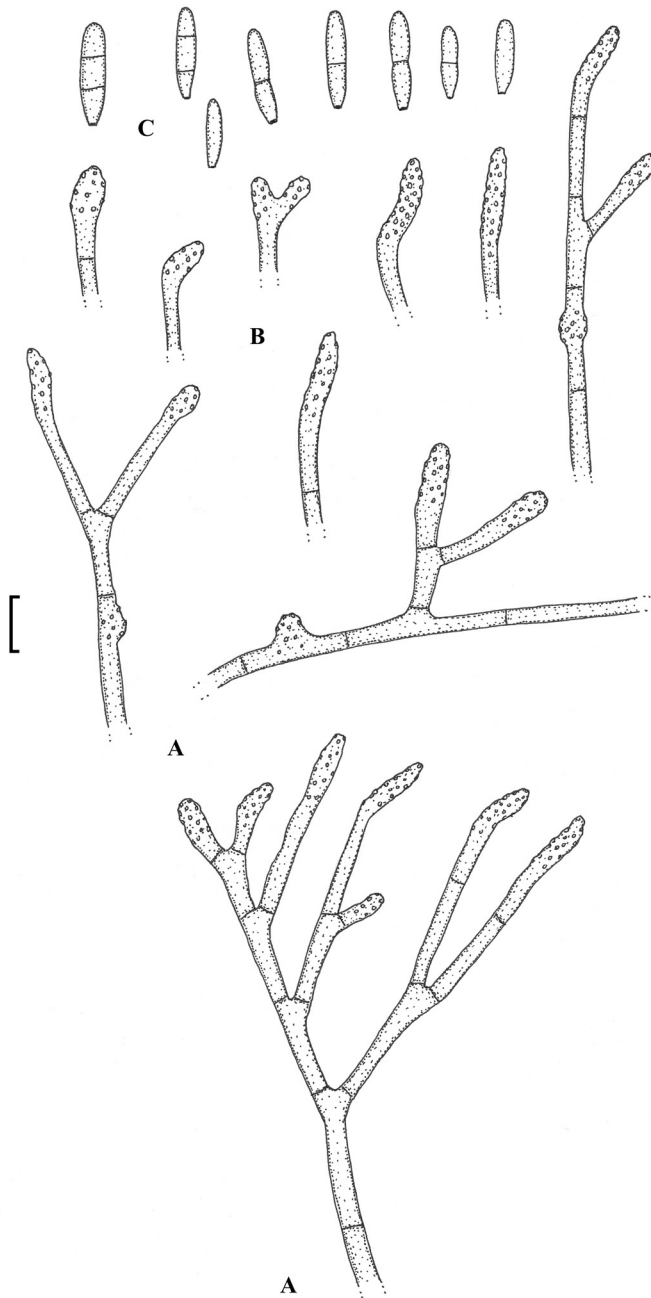


Fig. 5. *Gonatophragmium lichenophilum* (based on HAL 2686 F, holotype). A. Conidiophores. B. Conidiophore tips. C. Conidia. Scale bar = 10 μ m (U. Braun del.)

species of *Acrospermum* has not yet been established. *Gonatophragmium* is readily discernible by having pigmented, branched (mostly multibranched) conidiophores formed as erect to decumbent threads with terminal and intercalary conidiogenous cells which are often swollen around fertile portions with mostly numerous conspicuous conidiogenous loci. The loci are denticle-like, somewhat bulging, at least refractive and in front view visible as minute circles. The conidia are formed singly and amero- to phragmosporous.

Gonatophragmium mori, the type species of *Gonatophragmium*, is a tropical-subtropical leaf-spotting species on a wide range of hosts, well characterised by having straight to usually curved, (1–)3(–7)-septate conidia, to about 5 µm wide (Ellis 1971). *G. mangiferae* J.L. Mulder (Mulder 1973) was introduced for a similar phragmosporous species with wider conidia, 5–7 µm. *G. kuanense* A.N. Rai (Rai 1996), described from India, has 2–3-septate, curved conidia formed on very conspicuous, conoid denticles. Tripathi & Tripathi (2003) described 11 new *Gonatophragmium* species. All of them belong to the *G. mori* complex with mainly 3-septate conidia. Differences between these species and *G. mori* were not properly worked out and the variability of *G. mori* was not sufficiently taken into consideration. The authors used, for instance, the length of conidiophores described in Ellis (1971) to be up to 500 µm, and compared it with measurements of conidiophores of their own new species, but this value undoubtedly refers to decumbent threads interpreted by Deighton (in Cjep & Deighton 1969) and Ellis (1971) as branched conidiophores, whereas Tripathi & Tripathi (2003) considered lateral branches arising from decumbent threads as genuine conidiophores. For a few species, e.g. *G. daedalacanthi* M.S. Tripathi & V. Tripathi, the authors described “bands” on septa, but did not clearly explain the appearance and meaning of these “bands”. Besides, these “bands” are not clearly shown in the drawings. We agree with Singh et al. (2009) that all species described by Tripathi & Tripathi (2003) should better be considered synonyms of *G. mori*, at least tentatively pending more data and information to the latter species, including molecular examinations and host range studies.

Several species with 0–1-septate conidia, comparable with *G. lichenophilum*, have been described, but all of them are leaf-spotting species. *G. lichenophilum* is the first lichenicolous species of this genus and the first from Europe at all. *G. obscurum* U. Braun & C.F. Hill (Braun & Hill 2002) was introduced for a species from New Zealand collected on *Psidium guajava* with 0–1(–3)-septate, ellipsoid-ovoid to subcylindrical-fusiform, straight, slender conidia with subacute apex, 10–20 × 2–4 µm. The description of *G. epilobii* U. Braun & C.F. Hill (Braun & Hill 2008) was based on a culture isolated from leaf spots on *Epilobium ciliatum* in New Zealand. This species is characterised by having small, 0–1-septate conidia, 5–11 × 2–3.5 µm, with a length/breadth ratio of 1.5–3. *G. mayteni* S.K. Singh, L.S. Yadav & P.N. Singh (Singh et al. 2009), described from India on *Maytenus rothiana*, resembles *G. epilobii* but differs in having wider conidiophores, 3–7 µm, with thickened walls, short clavate-cylindrical conidia, 6–17 × 2–3 µm. *G. triuniae* Crous & Summerell (Crous et al. 2014), isolated from leaves of *Triunia youngiana* in Australia, is well-characterised and distinguished from *G. lichenophilum* and all other recognised species of *Gonatophragmium* by having very long conidiophores, 200–280 µm, composed of an erect stipe and branched upper portion as well as short clavate, 1-septate, pale brown conidia.

The recognised species of *Gonatophragmium*, including *G. mori* s. lat. in its current wider sense, can be keyed out as follows:

- 1 Conidia 1–7-septate, mostly 3-septate or 2–3-septate, straight to often curved; tropical-subtropical species, causing leaf spots 2
- 1* Conidia 0–1(–3)-septate, mostly more or less straight 4
- 2 Conidia mostly 2–3-septate, arising from very conspicuous, conoid denticles; on *Miliusa tomentosa* *G. kuanense*
- 2* Conidia (1–)3(–7)-, denticles not conoid, truncate to obtuse 3
- 3 Conidia 3–5 µm wide; on a wide range of hosts, causing leaf spots *G. mori*
- 3* Conidia 5–7 µm wide; on *Mangifera indica* *G. mangiferae*
- 4 Conidiophores 200–280 µm long, composed of an erect stipe and branched upper portion; conidia short clavate, 1-septate, pale brown; on *Triunia youngiana*
. *G. triuniae*
- 4* Conidiophores much shorter, to about 120 µm, branched on different levels, ramifications not confined to the upper portion; conidia ellipsoid-ovoid, subcylindrical to fusiform, subhyaline to pale yellowish, greenish or olivaceous 5
- 5 Conidiophores 3–7 µm wide, thick-walled; leaf-spotting fungus on *Maytenus rothiana*
. *G. mayteni*
- 5* Conidiophores 2–4(–5) µm wide, thin-walled 6
- 6 Conidia small, 5–11 × 2–3.5 µm, average length < 10 µm, 0–1-septate; isolated from leaf spots on *Epilobium ciliatum* *G. epilobii*
- 6* Conidia larger, (7–)9–20 × 2–4.5 µm, average length >10 µm, 0–1(–3)-septate 7
- 7 Conidiophores rather short, 5–80 µm long, average length < 50 µm; conidia straight, slender, 10–20 × 2–4 µm, often fusiform, apex subacute; on *Psidium guajava*, causing leaf spots *G. obscurum*
- 7* Conidiophores longer, to 120 µm; conidia ellipsoid-ovoid, subcylindrical, but not fusiform, (7–)9–15(–17) × (2.5–)3–4(–4.5) µm, apex obtuse, rounded; lichenicolous on *Xanthoria parietina* *G. lichenophilum*

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