Stigmidium cladoniicola, a new lichenicolous fungus from Northern Ural, Russia

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Stigmidium cladoniicola is described as new to science from *Cladonia macrophylla* in Northern Ural.

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In summer 1997 MZ studied lichens and lichenicolous fungi in Pechora-Ilych State Reserve of Russia (Zhurbenko 2004, Hermansson et al. 2006). The area is located within the taiga zone in the headwaters of Pechora and Ilych rivers, at the eastern boundary of Europe. In the mountainous part of the reserve (Northern Ural), MZ found a rich collection of a *Stigmidium* Trevis. growing on *Cladonia macrophylla* that is here described as new to science.

Material and methods

The material was examined by standard microscopic techniques using microscopes MBS-1 and Mikromed-2. Photographs were taken by a Nikon Coolpix 5000 camera. The material was mounted in water, 10% KOH (K), 1% solution of Brilliant Cresyl blue (BCr) or Congo red (CR). The amyloid reactions were tested in 1% Lugol's iodine solution, directly (I) and after a KOH pre-treatment (K/I). The estimated values of the size of asci and ascospores and length/breadth ratio (l/b) of the ascospores have been given as: (min.–){X–SD}–*X*–{X+SD}(–max.), where min. and max. are the extreme values, X the arithmetic mean, and SD the corresponding standard deviation. Measurements of asci were rounded to the nearest 1 µm, those of the ascospores to the nearest 0.5 µm. The holotype is deposited in the mycological herbarium of the V. L. Komarov Botanical Institute in St. Petersburg (LE).

Stigmidium cladoniicola Zhurb. & Diederich *sp. nov.*

Fungus lichenicola in thallis *Cladoniae macrophyllae* crescens, insignis ascomatibus atris, subglobosis, semi-immersis, 30–80 µm diam., peridio olivaceobrunneo, hymenio I–, hamathecio nullo, ascis 33–42 × 13–16 µm, 8-sporis, ascosporis hyalinis, levibus, 11.5–15 × 3-4 µm, non pseudotetrablasticis.

Type: Russia, Komi Republic, Troitsko-Pechorskii Region, Northern Ural, headwaters of the Pechora River, Pechora-Ilych State

Reserve, 165 km ESE of Troitsko-Pechorsk, valley between Yanypupuner Range and Mt. Medvezh'ya, 62°04'N, 59°08'E, alt. 500 m, on *Cladonia macrophylla* growing over huge diabase pillars in *Abies* forest, 4 July 1997, M. Zhurbenko 97248 (holotype LE 210443).

Fig. 1.

Vegetative hyphae poorly developed, pale to medium olive-brown, smooth, pigmentation even, composed of elongate cells 3–5 µm diam., constricted at the septa, sparsely branched, immersed in the host tissues, BCr+ blue, I–. *Ascomata* perithecioid, (brownish-) black, shiny, subglobose, sometimes somewhat conical above, with a rather conspicuous ostiole, without appendices or projections, 30–80 µm diam., semi-immersed in the host thallus to sessile, numerous, dispersed, occasionally adjacent. *Peridium* olive-brown, evenly coloured, in surface view of *textura angularis* or *textura epidermoidea*, 5–8 µm thick, composed of unevenly pigmented polyhedral cells 3–8 µm across, K+ olive, BCr+ blue, I–. *Hymenial gel* I–, K/I–. *Ostiolar and interascal filaments* not observed. *Asci* bitunicate, usually markedly thickened below the middle, often with a distinct 2–8 µm long foot, endoascus strongly thickened above, internal apical beak often distinct and long, (30–)33–*38*–42(–48) × (10–)13–*14*–16(–17) µm (n=36, in water), 8-spored, BCr+ violet, I–, K/I–, CR+ coral with paler area just above apical beak. *Ascospores* colourless, surface smooth, without halo, narrowly obskittle-shaped, occasionally narrowly obovate, with the greatest breadth above the middle, (9.0–)11.5–*13.0*–15.0(–16.5) × 3.0–*3.5*–4.0(–5.0) µm, l/b = (2.3–)3.0–*3.5*–4.0(–5.0) (n=75, in water), with one median septum, not or slightly constricted at the septum, non-pseudotetrablastic, but sometimes with 1–2 oil guttules per cell, overlapping in 2–3 rows in an ascus, BCr+ violet. *Anamorph* not found.

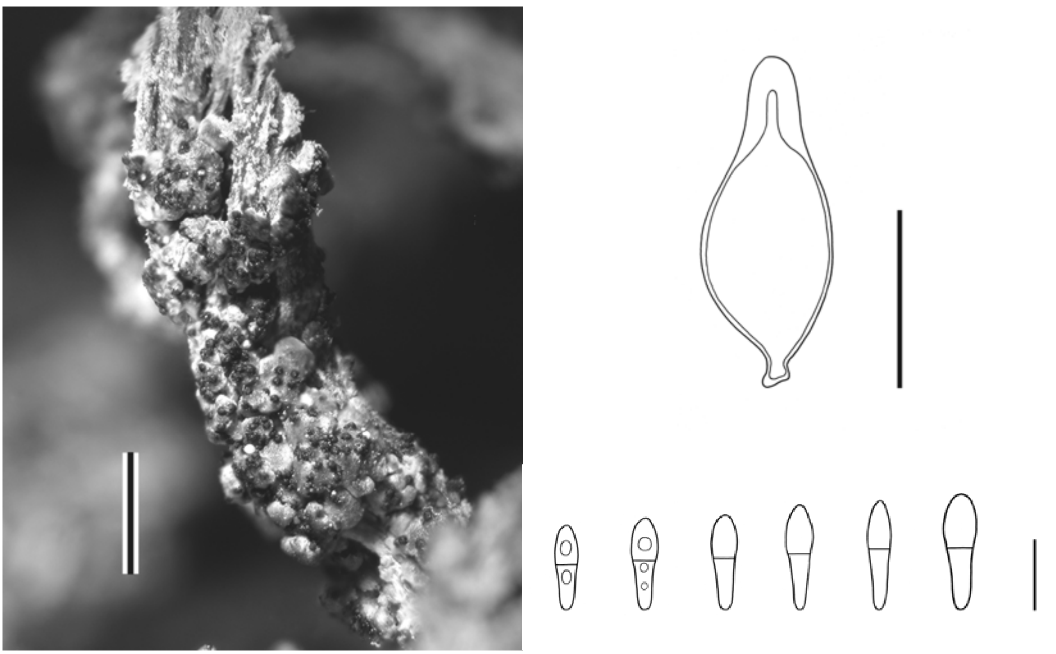

Figure 1. *Stigmidium cladoniicola* (holotype), habitus (left), ascus and ascospores (right). Bars: 1 mm (habitus), 20 µm (ascus), 10 µm (spores).

Matrix and biology. The fungus grows saprotrophically or parasymbiotically on both sides of basal and podetial squamules, and on podetia of old, moribund *Cladonia macrophylla*.

Distribution. The species is known only from the type locality in Northern Ural (Russia).

Observations. *Stigmidium* is a widespread lichenicolous genus with about 75 accepted species growing on a wide range of hosts (Lawrey & Diederich 2003). However, no *Stigmidium* species have been known so far to grow on members of the *Cladoniaceae*.

The only major modern revision of *Stigmidium* species was done by Roux & Triebel (1994) who revised the species previously named *Pharcidia epicymatia* or *Stigmidium schaereri*. At that time these authors distinguished between three groups: *Stigmidium* s. str. (14 species studied, characterized by narrow, 2-celled pseudoparaphyses with unequal cells), the group of *S. squamariae* (de Lesd.) Cl.Roux & Triebel (only one species recognized, characterized by the absence of distinct pseudoparaphyses), and the group of *S. placynthii* Cl.Roux & Navarro-Rosinés (two species recognized, characterized by large pseudoparaphyses composed of 3–5 more or less equal-sized cells). One of the species of the *S. placynthii* group, *S. catapyrenii* Cl.Roux & Triebel, was later recognized as a synonym of *Epibryon conductrix* (Norman) Sacc. & D.Sacc. (Hoffmann & Hafellner 2000). Recent studies of the hamathecium of *Stigmidium squamariae* led to the inclusion of that species in the *S. placynthii* group (Roux & Triebel 2005). A further group of several species, the so-called *Stigmidium psorae*-group (Calatayud & Triebel 2003, Roux & Triebel 2005, unpublished data of Zhurbenko & Triebel) possibly merits rank of a separate genus close to *Sphaerellothecium* Zopf.

A careful examination of many ascomatal sections by the first author did not reveal the presence of any visible hamathecial filaments, suggesting a relationship to *Stigmidium squamariae*. However, that species is distinguished from the new *S. cladoniicola* by shorter and broader ascospores, 9–13 × 4–5 µm, and by perithecia that are dark brown above but colourless in the lower, immersed parts (Roux & Triebel 1994).

As pseudoparaphyses in *Stigmidium* are sometimes difficult to observe and as the hamathecium of most accepted *Stigmidium* species is still insufficiently studied, the new species should be compared with the other known species of the genus. Amongst the species recognized and described by Roux & Triebel (1994) as belonging to *Stigmidium* s. str., just three have non-pseudotetrablastic ascospores: *S. collematis* Cl.Roux & Triebel and *S. joergensenii* R.Sant. are easily distinguished by much smaller ascomata (30–45 µm diam.), and *S. pseudopeltideae* Cl.Roux & Triebel by distinctly larger ascomata (90–100 µm diam.).

In the key to all known *Stigmidium* and *Pharcidia* species by Clauzade et al. (1989), most taxa differ significantly from the new species, either by ascospore size, ascomatal size, ascomatal pigmentation or effect on the host. The most similar species, *S. rivulorum* (Kernst.) Cl.Roux & Nav.-Ros., differs from *S. cladoniicola* in its peridium being paler below, a lower length/breadth ratio (2.7–3.2) and a different host selection (*Polyblastia*, *Staurothele*, *Verrucaria*, all members of the *Verrucariaceae*) (Molitor & Diederich 1997, Roux & Navarro-Rosinés 1994, Zhurbenko & Hafellner 1999).

Amongst the more recently described species, *Stigmidium acetabuli* Calatayud & Triebel differs by shorter ascospores (8–10.5 × 3–4 µm) and distinct, 2-celled pseudoparaphyses (Calatayud & Triebel 2001); *S. arthrorhaphidis* Hafellner & Obermayer has shorter and broader ascospores (11–12 × 4–4.5 µm) (Hafellner & Obermayer 1995); *S. bellemerei* Cl.Roux & Nav.-Ros. is distinguished by larger, pseudotetrablastic ascospores (15–18 × 4–5.5 µm) (Roux et al. 1998); *S. cartilagineae* Calatayud & Triebel differs by an I+ violet hymenial gel (Calatayud & Triebel 2003); *S. clauzadei* Cl.Roux & Nav.-Ros. has slightly longer and much broader ascospores (12.5–17.5 × 5–6.5 µm) (Roux & Navarro-Rosinés 1994); *S. conspurcans* (Th.Fr.) Triebel & R.Sant. has larger ascomata (80–100 µm diam.) and distinctly broader ascospores (12–15 × 4.5–5.5 µm) (Triebel 1989); *S. epixanthum* Hafellner differs by larger ascomata (120–180 µm diam.) and much broader ascospores (5–7 µm broad) (Hafellner et al. 2002); *S. grex* Alstrup & Olech has shorter ascospores (9.5–11.5 × 3–4 µm) and densely aggregated ascomata (Alstrup & Olech 1996); *S. heterodermiae* Etayo has slightly shorter and distinctly narrower ascospores (10.5–13 × 2.5–3 µm) (Etayo 2002); *S. lecidellae* Triebel, Roux & Le Coeur differs by pseudotetrablastic ascospores (Roux et al. 1995); *S. leprariae* Zhurb. differs by 1(–3)-septate, colourless to often pale grey-olive, slightly broader ascospores (12.5–15 × 4–5 µm) (Zhurbenko 2007); *S. leptogii* Etayo has slightly shorter and distinctly broader ascospores (9–12.5 × 4–4.5 µm) (Etayo 2002); *S. microcarpum* Alstrup & J.C.David has smaller ascomata (35–50 µm diam.) and much smaller ascospores (7–9 × 2–3 µm) (Alstrup 1993); *S. microsporum* Etayo & Osorio has particularly small ascospores (5.5–6 × 2–2.5 µm) (Etayo & Osorio 2004); *S. neofusceliae* Calatayud & Triebel has much broader ascospores (12–15 × 5–6 µm) and shows an I+ violet reaction of hymenial gel, ascomatal wall and vegetative hyphae (Calatayud & Triebel 1999); *S. pumilum* (Lett.) Matzer & Hafellner has slightly shorter and often broader ascospores (l/b ratio c. 2.2) (Matzer & Hafellner 1990); *S. rouxianum* Calatayud & Triebel has much larger ascospores (14.5–18 × 6–7 µm) and ascomata (80–200 µm diam.), and distinct, long, branched and anastomosed interascal filaments (Calatayud & Triebel 2003); *S. squamarinicola* Calatayud & Triebel has larger ascomata (85–120 µm diam.), broader ascospores (13–15 × 5–6.5 µm, and long, branched and anastomosed interascal filaments (Calatayud & Triebel 2003); *S. tabacinae* (Arnold) Triebel has pseudo-tetrablastic ascospores (Triebel 1989); *S. tetrasporum* Etayo has larger ascomata (80–150 µm diam.) and 4-spored asci (Etayo 1994); *S. triebeliae* Etayo has a net of brown filaments spreading over host thallus (Etayo 2000); *S. xanthoparmeliarum* Hafellner has broader ascospores (13–16 × 4–5.5 µm) becoming brownish and often 3-septate when mature (Hafellner 1994).

In most known *Stigmidium* species occurring on foliicolous lichens (Matzer 1996), ascospores are either shorter, or they become divided in part-spores in squash mounts. *Stigmidium vezdae* Matzer has narrower ascospores (12–15 × 2–3 µm), becoming faintly brownish when overmature, asci are slightly shorter (25–36 × 9–14 µm), and vegetative hyphae more numerous.

Discussion. The genus *Stigmidium* is one of the most diverse, and at the same time one of the most difficult genera of lichenicolous fungi. From our personal experience, it is evident that many unknown species remain to be discovered and described. The small number of taxonomically useful morphological characters, the great difficulty in studying the nature of hamathecial filaments, the poorly known morphological variability of many species, and the extreme similarity between different species has led many authors to recognize additional species mainly based on distinct host-preferences, combined with minor morphological differences. This tendency to accept very narrow species concepts has proved successful in both *Stigmidium* and many other genera of lichenicolous fungi, unfortunately leading some authors in distinguishing new species based only on a different host-selection. Although such species often become accepted later on, we would like to stress the importance of comparing new taxa with all known similar species, and to find morphological characters to characterize them independently of the host-selection.

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