

***Abrothallus halei* (Ascomycota, *incertae sedis*), a new lichenicolous fungus on *Lobaria* species in Europe and North America**

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Abstract: The new lichenicolous fungus, *Abrothallus halei* sp. nov., is described. The species is characterized by having 4-celled ascospores with a strongly constricted median septum, which split into two 2-celled part-spores, even when still inside the ascus. This is the first *Abrothallus* known from the genus *Lobaria*, and the species is reported from Norway and the USA, occurring on *L. quercizans* and *L. pulmonaria*.

Key words: ascomycetous fungi, lichen, new species, part-spores, taxonomy

Introduction

Lichenicolous fungi have been studied for more than 200 years (Hawksworth 2003; Lawrey & Diederich 2003), and amongst the earliest recognized was *Lichen parasiticus* Sm. 1808, now known as *Abrothallus parmeliarum* (Sommerf.) Arnold 1874. The genus *Abrothallus* De Not. 1845 itself was amongst the first few generic names introduced for obligately lichenicolous fungi (De Notaris 1845, 1846), and was monographed by Lindsay (1857) who treated it in a broad sense to include a wide range of lichenicolous fungi. Modern usage follows the circumscription of Kotte (1909). The genus is characterized by having more or less convex apothecioid ascomata which lack an obvious exciple, and are often covered with greenish pruina; the asci are fissitunicate, with four to eight, 2–4-celled, dark brown or greenish

asymmetric ascospores with an evident ornamentation, sometimes separating into part-spores; the interascal filaments are ramified to anastomosed paraphyses; the epithelial layer contains granules which can dissolve in potassium hydroxide, and the anamorph, where known, belongs to *Vouauxiomyces* Dyko & D. Hawksw. 1979. The placement of the genus within the Ascomycota is uncertain pending molecular sequence data. Species of the genus are found on various foliose and fruticose lichens, including several genera from the family *Parmeliaceae*, from the sub-order *Peltigerinae*, and the genera *Ramalina*, *Stereocaulon* and *Cladonia*.

Despite its long history, the infrageneric taxonomy has remained controversial, especially with regard to host-specificity, and new taxa continue to be described (Wedin 1994; Cole & Hawksworth 2001; Etayo 2002; Diederich 2003; Etayo & Osorio 2004; Hafellner *et al.* 2008). There are 57 names in the genus listed in *Index Fungorum* (<http://www.indexfungorum.org>, consulted 3 June 2010), of which 23 species of *Abrothallus* are currently accepted, although the species concepts of those occurring on parmelioid lichens merit more critical study, including molecular phylogenetic methods. Four species are known growing on *Peltigerales*, namely *Abrothallus welwitschii* Tul. 1852,

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A. secedens Wedin & R. Sant. 1994, *A. granulatae* Wedin 1994 and *A. stictarum* Etayo 2002. Here we describe a further new species from *Peltigerales* growing on *Lobaria*, an additional host genus for *Abrothallus*.

Material and Methods

The material examined is deposited in M, MAF and UPS. The morphological characters of dry herbarium specimens were studied under a Leica S4E and Zeiss Stemi SV11 dissecting microscope using standard techniques. Microscopic characters were examined with a Leica DM750 and Zeiss Axioskop2plus research microscope using razor-blade-cut sections mounted in water and mounted in *c.* 5% KOH (K) solution. The colour reactions were observed using 50% NH₃ (N), K and Lugol's iodine solution (I), the latter both with (K/I) and without pre-treatment with K. Photographs were taken with a Canon PowerShot G2 digital camera attached to the microscopes. All photomicrographs were taken in water.

The sizes of ascospores, asci, cells of the hypothecium and ascomata are presented as: minimum value – (average) – maximum value. All size values of microscopical characters were measured in the holotype in water.

Taxonomy

***Abrothallus halei* Pérez-Ortega, Suija, D. Hawksw. & R. Sant., sp. nov.**

Mycobank no.: MB 518660

Fungus lichenicola in genere *Lobaria* vigens. Ascomata apothecia, superficialia, convexa ad inflata, ad basim constricta, viridi-pruinosa, 200–(300)–550 µm diam. Asci clavati, bitunicati, octospori. Ascospores ellipsoidae, brunneae, verruculosae, 3-septatae, secedentes, 9–(10·7)–14 × 3·2–(4·0)–5·0 µm.

Typus: USA, Minnesota, Lake Co., Superior National Forest, 14·5 km W of Tofte, east of Hare Lake, 47°36'N 91°02'W, elev. 550 m, mature sugar maple stand with some old *Betula alleghaniensis*, on *Lobaria quercizans* on bark of *Acer saccharum*, 28 July 1999, C. Wetmore 83138 (M-0151980—holotypus; isotypes are to be distributed in Triebel, *Microfungi Exsiccati*).

(Figs 1 & 2)

Mycelium immersed, K/I–. *Ascomata* apothecioid, immersed when very young, soon superficial, on the host apothecia or thallus, convex to plane, black, intensively green pruinose, especially when young, the pruina sometimes disappearing in mature apothecia, width 200–(300)–550 µm, height

c. 150 µm, constricted at the base, ± stipitate; *epithecium* with brown to dark brown pigment granules dissolving in K; hymenium *c.* 50 µm tall, hyaline in the lower part, with an olivaceous greenish pigment in the upper part, K+ green intensified, N± violet; *exciple* *c.* 60–70 µm wide in vertical section, composed of radiating septate hyphae; *hypothecium* pale brown, *c.* 50 µm tall, of rectangular cells, 5–(5·6)–6 × 4–(4·9)–6 µm. Interascal filaments dichotomously branched, *c.* 1·5 µm wide, the tip only slightly widened to 2–2·5 µm. *Asci* bitunicate in structure and fissitunicate, clavate, thickened at the apex, with a narrow internal apical beak when young, 40–(47·5)–60 × 9–(10)–12 µm, mainly 8-spored but some asci 4- or 6-spored. *Ascospores* brown, 4-celled when mature, young spores 2-celled, 9–(10·7)–14 × 3·0–(4·0)–5·0 (upper cell) / 3·0–(3·0)–4·0 (lower cell) µm (*n* = 20), asymmetrical, verruculose, strongly constricted at the middle septum, separating into two part-spores within the ascus when mature. *Anamorph* not observed.

Intraspecific variation. The morphological variation is mainly limited to the extent of the pruinosity over the surface of the ascomata. We also noted that in *Cole* 9293 (MAF), 6-spored asci dominated over 8-spored asci, while the opposite was noted in the other specimens. In the same specimen (*Cole* 9293), the hypothecium was also somewhat taller, up to *c.* 110 µm tall.

Hosts. So far, all extra-European specimens are recorded from *Lobaria quercizans*, while the single European collection is from *L. pulmonaria*. The species grows mainly on the apothecia of the host which turn black, most probably due to the action of the lichenicolous fungus. A darkening of the infected thallus area was also seen when *L. pulmonaria* was the host.

Etymology. The name was chosen based on the herbarium designation *Abrothallus halei* (as '*A. haleii*' R. Sant. *nom. prov.*) coined but not published by R. Santesson, probably in the 1960s. The epithet honours the

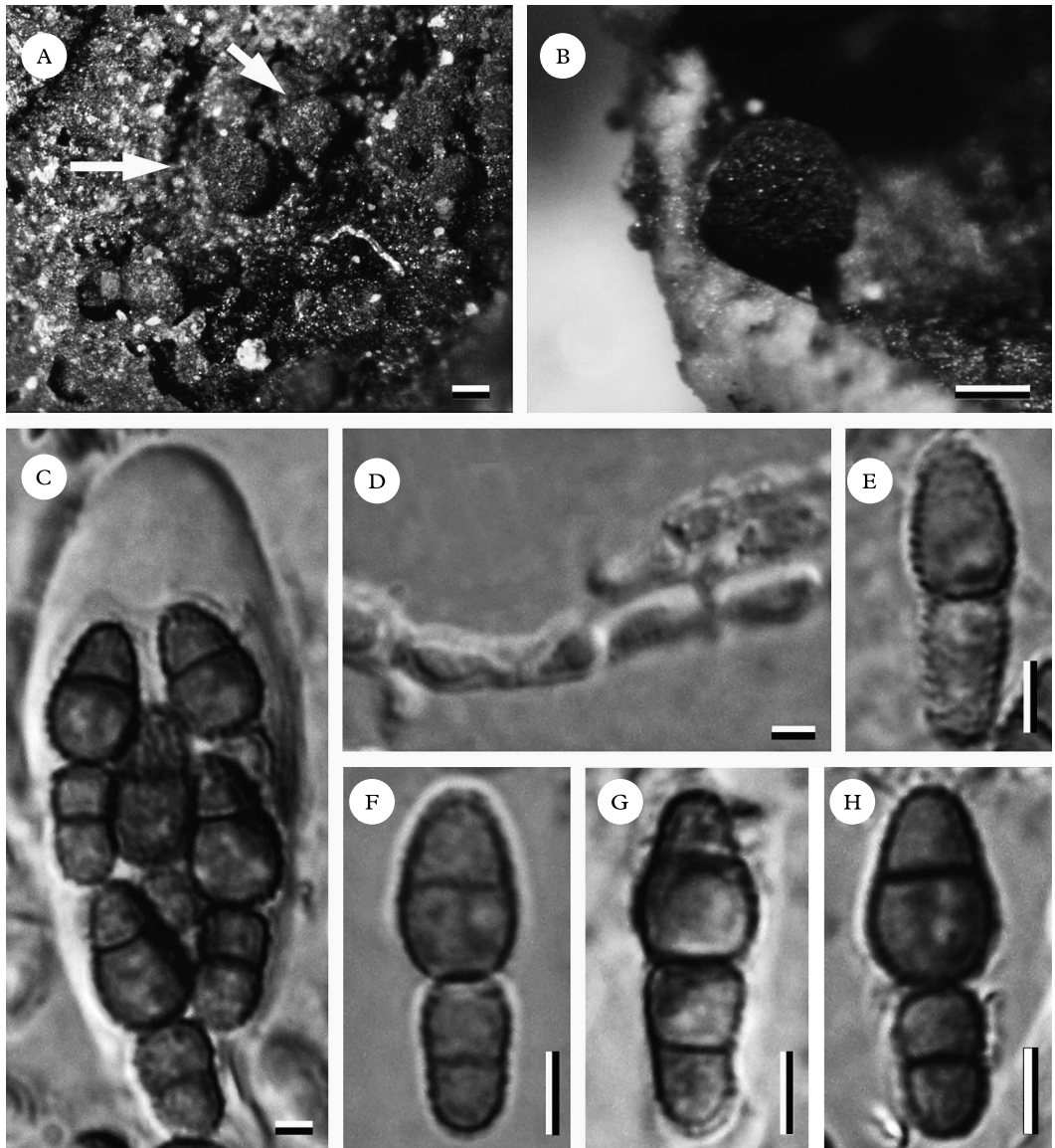


FIG. 1. *Abrothallus halei*. A, apothecia on necrotic apothecia of *Lobaria quercizans*, arrows point to apothecia; B, detail of an ascoma; C, a mature ascus with ascospores; D, paraphysis; E, young ascospore showing one septum; F–H, mature ascospores. C, D, E and G with differential interference contrast. Scales: A & B = 150 μm ; C = 25 μm ; D–H = 2.5 μm .

American lichenologist, the late Mason E. Hale (1928–1990), who had a special interest in the *Lobaria amplissima*/*L. quercizans* complex (Hale 1957) and distributed material of the new species in an exsiccate (see below).

Distribution. This new species is currently known from three localities in the USA (West Virginia, Maine, and Minnesota) and from one locality in Europe (Norway). *Abrothallus halei* may now be extinct in the Maine locality as an intensive search there

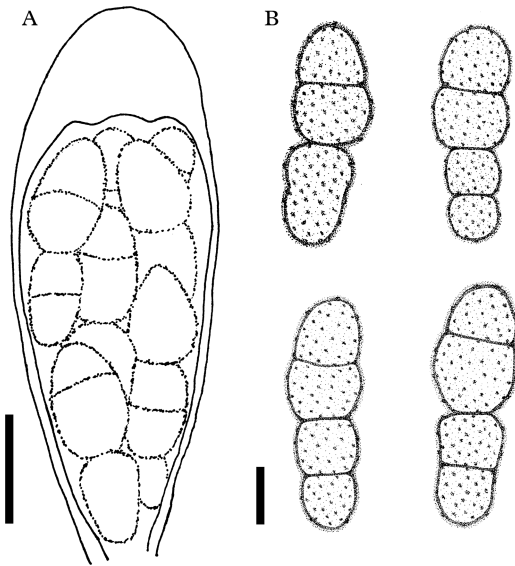


FIG. 2. *Abrothallus halei*. A, ascus; B, ascospores. Scales: A = 10 μ m; B = 3 μ m.

by DLH on two occasions in 2008 failed to find the species again, several of the mature maples formerly present having been cut down as part of a road-improvement scheme, although *Lobaria quercizans* was still abundant on some of the remaining roadside trees.

Additional specimens examined. **USA:** *West Virginia:* Pocahontas Co., at Gaudier Knob, on apothecia of *Lobaria quercizans*, vii 1956, R. Santesson [Hale, Lichenes Americani Exsiccati no. 53, sub *L. quercizans*] (UPS: F-156131/450256); *Maine,* Hancock Co., Rt. 182, 7 miles west of Rt. 1, north shore of Tunk Lake, 44°27'36"N 67°55'58"W, on *L. quercizans* on *Acer rubrum*, M. S. Cole 9293 (MAF).—**Norway:** Sør-Trøndelag, Rissa, the valley of the river Sörelv, not far from the river Stavsetelv (c. 3 km E of Vollavatn), on thallus of *L. pulmonaria* on *Salix caprea*, 1961, R. Santesson 14334c (UPS: F-156140/450265).

Discussion

Attention was first drawn in print to this species by Santesson (in Hawksworth 1990) who gave ascospore measurements of 11–15 \times 4–5 μ m for the yet undescribed species. *Abrothallus halei* is the fourth species of the genus with 3-septate ascospores. *Abrothallus*

bryoriarum Hafellner 1994, *A. suecicus* (Kirschst.) Nordin 1964, and *A. stictarum* Etayo 2002 also have ascospores with three septa, however they differ from *A. halei* by having larger ascospores: (16–)17–20 \times 6–8 μ m in *A. bryoriarum* (Hafellner 1994), 14–17(–20) \times 5–7 μ m in *A. suecicus* (Nordin 1964), and 13.5–18 \times 5–6 μ m in *A. stictarum* (Etayo 2002). Furthermore, *A. bryoriarum* grows on *Bryoria* species, *A. suecicus* on *Ramalina* species, and *A. stictarum* on *Sticta* species, and the ascospores are much less constricted at the central septum. Part-spores (semi-spores *sensu* Hawksworth 1990) occur in several 1-septate species of *Abrothallus*, namely in *A. cladoniae* R. Sant. & D. Hawksw. 1990, *A. secedens* Wedin & R. Sant. 1994, *A. stereocaulorum* Etayo & Diederich 2002, and in some undescribed species (A. Suija & S. Pérez-Ortega, personal observation). However, *A. halei* is the first species of the genus reported to have 4-celled ascospores which separate into two 2-celled part-spores.

Abrothallus halei represents the fifth species growing on members of the *Peltigerales*, Ascomycota. The other four species described so far differ from *A. halei* in ascospore sizes and septation, as well as in growing on different host genera. *Abrothallus secedens* occurs on species of *Pseudocyphellaria* and has 1-septate ascospores that easily split into two part-spores (Wedin 1994); *A. granulatae* on *Pseudocyphellaria granulata* has characteristic 2-septate ascospores (Wedin 1994); *A. welwitschii* (Tulasne 1852) and *A. stictarum*, both on *Sticta* species have 1-septate and 1–3-septate ascospores, respectively (see above).

Dactylospora lobariella (Nyl.) Hafellner 1979 (syn. *Abrothallus lobariellus* (Nyl.) Zopf 1896), another lichenicolous fungus with dark brown septate ascospores growing on *Lobaria* species, is readily distinguished from *Abrothallus halei* by several characteristics. The ascomata of *D. lobariella* measure (0.14–)0.2–0.6 mm diam., have a distinct and raised black exciple which contains blue-violet K+ green granules, a disc which is generally plane to concave and only convex with age, asci which have an I+ blue sheath,

and ascospores which are consistently 1-septate, never break into part-spores, and measure 11–17 × 5–6 µm (Hawksworth 1975; Hafellner 1979). *Dactylospora lobariella* is known from Africa (Canary Islands), Europe, and North America where the hosts include *Lobaria pulmonaria*, *L. quercizans* and *L. virens*.

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