



Contributions to a revision of *Cercidospora* (Dothideales), 2: Species on *Lecanora* s. l., *Rhizoplaca* and *Squamarina*

Calatayud V¹, Navarro-Rosinés P² and Hafellner J³

¹Fundación CEAM, Parc Tecnològic, Ch. R. Darwin 14, ES-46980 Paterna, València, Spain

²Dept. de Biologia Vegetal (Botànica), Fac. de Biologia, Univ. de Barcelona, Av. Diagonal 645, ES-08028 Barcelona, Spain

³Institut für Pflanzenwissenschaften, Karl-Franzens-Universität, Holteigasse 6, A-8010 Graz, Austria

Calatayud V, Navarro-Rosinés P, Hafellner J 2013 – Contributions to a revision of *Cercidospora* (Dothideales), 2: Species on *Lecanora* s. l., *Rhizoplaca* and *Squamarina*. *Mycosphere* 4(3), 539–557, Doi 10.5943/mycosphere/4/3/8

Abstract

A study on the taxonomy, morphology and anatomy of the lichenicolous species of the genus *Cercidospora* (Dothideales, incertae sedis) growing on lichens of the genera *Lecanora* (Lecanoraceae), specifically of the *L. polytropa* group and the *L. saxicola* group (i.e. *L. muralis* sensu auct. group, *Protoparmeliopsis* spp.), *Rhizoplaca* (Lecanoraceae) and *Squamarina* (Stereocaulaceae) is presented. The following species are proposed as new: *Cercidospora barroana* on *Rhizoplaca peltata*, and *C. melanophthalma* on *Rhizoplaca melanophthalma*. *C. stenotropae* is proposed provisionally; this fungus grows on *Lecanora stenotropa* and other taxa of the *L. polytropa* group. A key for the species of the genus *Cercidospora* treated is provided.

Key words – *Ascomycota* – lichenicolous fungi – lichenized fungi

Introduction

This study is the second contribution to the revision of the genus *Cercidospora* (Dothideales, incertae sedis) which is being undertaken. It is centered on the species growing on lichens of the genera *Lecanora* s. l. (Lecanoraceae, Lecanorales), specifically of the *L. polytropa* group and *L. saxicola* group (i.e. *L. muralis* sensu auct. group, *Protoparmeliopsis* spp.), *Rhizoplaca* (Lecanoraceae, Lecanorales), and *Squamarina* (Stereocaulaceae, Lecanorales; fide Miadlikowska et al. 2006).

Of the six species here treated, three were previously known. Two species, *Cercidospora epipolytropa* and *C. macrospora* (= *C. ulothii*), have been profusely cited. The third, *C. crozalsiana*, is recently recovered (Navarro-Rosinés et al. 1995).

The general features of the genus *Cercidospora* have been described in detail in a first contribution for the revision of the genus (Navarro-Rosinés et al. 2009), as well as in the studies by Hafellner (1987), Grube & Hafellner (1990) and Navarro-Rosinés et al. (2004).

Material and methods

For the microscopic study of the morphology and anatomy of the species, sections of ascomata were prepared by hand, and mounted in water or, to increase the contrast, in lactophenol-

cotton blue. All measurements of the different structures were made in water. For the illustrations, a drawing tube fitted to the microscope was used. In the size of the ascospores, the values in italics indicate the average value of length and width, the values in brackets are the extreme values, and the remaining values are the extreme values after rejecting 10% of the highest and 10% of the lowest values. The nomenclature of the host species follows Clauzade & Roux (1985, 1987, 1989), Hafellner & Türk (2001) and Nimis (1993), except for some commented exceptions.

Key to the species of *Cercidospora* treated

1. Ascospores mostly over 25 μm long, from ellipsoid-fusiform to cylindrical; asci over 100 μm long. 2
- 1*. Ascospores, usually less than 25 μm long; asci not over 100 μm long. 3
- 2(1). Ascospores c. 30–38 \times 6–8 μm ; asci 90–145 \times 10–15 μm , 4-spored; ascomata 250–340 (–400) μm diam; on *Rhizoplaca peltata*. *C. barroanoana*
- 2*. Ascospores somewhat smaller, c. 24.5–32 \times 5.5–7 μm ; asci 85–120 \times 10–14 μm , with (2–)4 spores; ascomata c. 200–280 μm diam.; on *Squamarina* spp. *C. crozalsiana*
- 3 (1*). Asci mostly 8-spored. 4
- 3*. Asci mostly 4-spored. 5
- 4(3). Ascospores c. 18–22 \times 5–6.5 μm , ellipsoid or, mostly, fusiform; asci c. 70–90 \times 10–15 μm , with (6–)8 spores; ascomata 170–330 μm diam.; on *Rhizoplaca melanophthalma*. *C. melanophthalmae*
- 4*. Ascospores somewhat smaller, c. 15–19 \times 5–6 μm , oval-ellipsoid; asci 50–70 \times 9–13 μm , with (4–6–)8 spores; ascomata 130–220 μm diam.; on *Lecanora polytropa* s. str., *L. intricata* and other taxa of *L. polytropa* group. *C. epipolytropae*
- 5 (3*). Ascospores c. 20–25 \times 4–6 μm , narrowly ellipsoid or fusiform; asci c. 65–90 \times 9–11 μm , with 4 (–8) spores; ascomata 150–250 μm diam.; on *Lecanora saxicola* group (= *Lecanora muralis* sensu auct. group). *C. macrospora*
- 5*. Ascospores c. 16–21 \times 5–6 μm , from narrowly ellipsoid to slightly fusiform; asci c. 40–55 \times 8–10 μm , with (2–)4 spores; ascomata c. 110–150 μm diam.; on *Lecanora stenotropa* and other taxa of *L. polytropae* group (and possibly on *Rhizoplaca aspidophora*). *C. stenotropae*

The species

Cercidospora barroanoana Calat. & Nav.-Ros., sp. nov.

Fig. 1–9 a-e

Mycobank 516548

Ascomata perithecioidea, totaliter immersa in thallis hospitis. In sectione transversali pseudothecia globosa, 250–340 (–400) μm in diametro. Parietis ascomatum apicaliter violascens, parce incrassatus, basaliter subhyalini-violascens, 30–40 μm crassus. Paraphysoides copiosae, (1.5–)2(–3) μm in diametro. Asci cylindrici, circa 90–145 μm longi et 10–15 μm lati, tetraspori. Ascosporae (27–)30–38(–40) \times (5–)6–8 μm magnae, incoloratae, longe ellipsoideo-fusiformentes vel (sub)cylindriceae, ad septum non aut parum constrictae, cellula superiore brevior crassioraque quam cellula inferior, tenuiter halonatae. *Cercidosporae macrosporae* et *C. crozalsianae* affinis, sed ab eis dissimilis pseudotheciis et ascosporis majoribus. Supra thallum *Rhizoplacae peltatae* vigens.

Type – Spain: Islas Canarias, Tenerife, Parque Nacional de El Teide, Roques de García, rocas volcánicas, 2125 m, 23.IX.1993, V. Calatayud (VAB-lich. 7436, holotype).

Host species of the type – *Rhizoplaca peltata* (Ramond) Leuckert & Poelt.

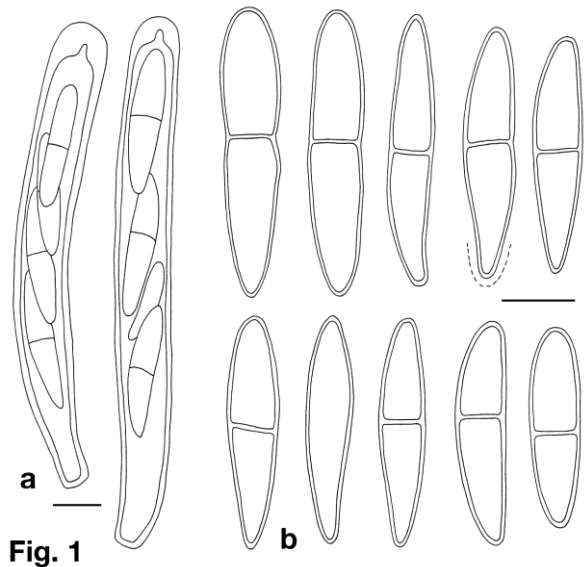


Fig. 1

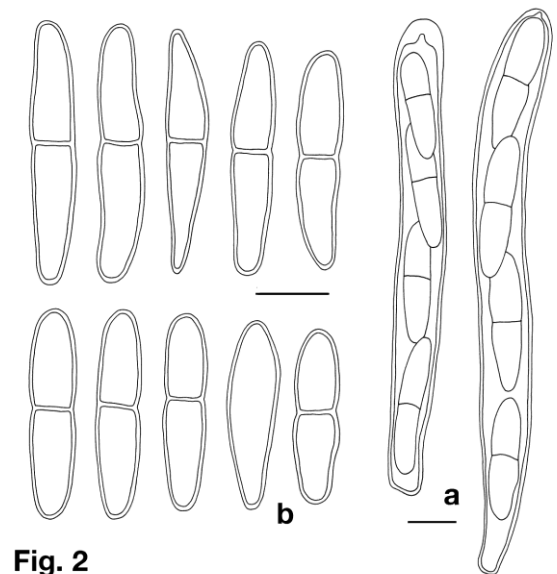


Fig. 2

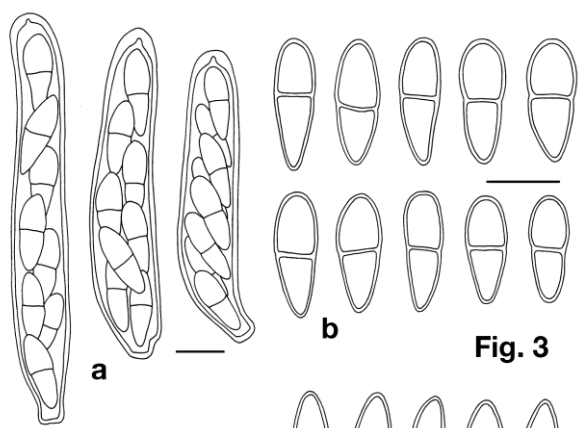


Fig. 3

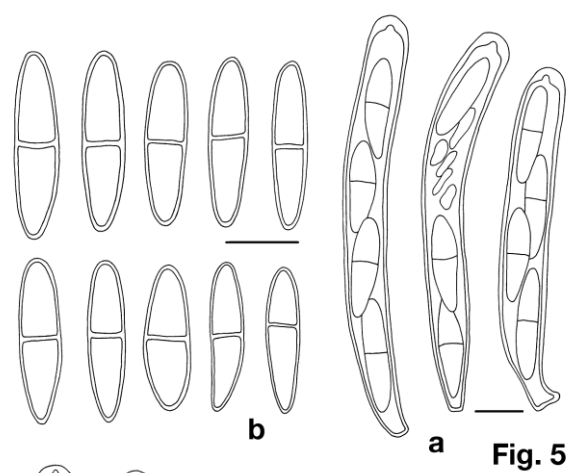


Fig. 5

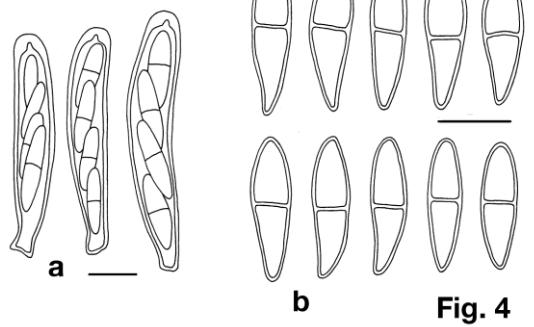


Fig. 4

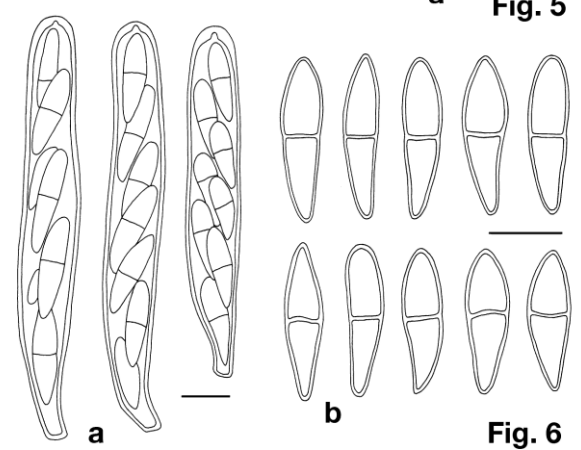


Fig. 6

Fig. 1 – *Cercidospora barroana* (holotype). **Fig. 2** – *Cercidospora crozalsiana* (Gordes, Vaucluse, France; BCN 13301-13305). **Fig. 3** – *Cercidospora epipolytropae* (Anielarra, Aragón, Spain; BCN-lich. 2549). **Fig. 4** – *Cercidospora stenotropae* (Meranges, Catalonia, Spain). **Fig. 5** – *Cercidospora macrospora* (Escatron, Aragón, Spain). **Fig. 6** – *Cercidospora melanophthalmae* (Col de Lautaret, Alpes sept. du Dauphinée, France; MARSSJ, Lichenes Alpium 49). In all figures: a, asci; b, ascospores. – Bars = 10 μ m.

Etymology – *barrenoana* (Lat.), belonging to Barreno; named after Dr. Eva Barreno (professor of Universitat de València).

Description – Ascomata perithecioid, 250–340(–400) μm diam., provided with a violaceous exciple, rarely with a greenish tinge in its upper part, less pigmented towards its base; in mature ascomata sometimes uniformly violaceous-colored throughout and with a greenish tinge, 30–40 μm thick towards the base. Paraphysoids abundant, (1.5–)2(–3) μm thick. Asci 90–145 \times 10–15 μm , cylindrical, 4-spored. Ascospores (27–)30–33.4–38(–40) \times (5–)6–6.8–8 μm , with a length/width ratio of (3.6–)4.3–5.0–5.8(–7.2) ($n = 59$), mostly 1-septate, but simple ascospores also abundant, colorless, narrowly ellipsoid-fusiform to almost cylindrical, slightly heteropolar, not or only slightly constricted at the septum, mostly with a clearly visible, gelatinous sheath, 1–2 μm thick, guttulate.

Remarks – *Cercidospora barrenoana* and *C. crozalsiana* are the two species in this study showing the largest asci and ascospores, and clearly exceeding the sizes of the structures of the rest of the taxa. *C. barrenoana* is the species of the genus with the largest ascospores, with a length of mostly 30–40 μm . In *C. crozalsiana*, the ascospores are slightly smaller, with a predominant length of 24–32 μm , and only occasionally with ascospores reaching 37 μm long. The ascomata of *C. barrenoana*, which are usually 250–340 μm in diam., but can reach 400 μm in some cases, is among the largest in the genus. In most of the *Cercidospora* species the diam. of the ascomata is clearly smaller. Only in *C. melanophthalmae* (see below) and *C. mutabilicola* sp. ined. (Navarro-Rosinés et al. 2009), can they also be over 300 μm wide.

Distribution and habitat – To date, *C. barrenoana* is known only from its type locality in Tenerife (Canary Islands), growing on *Rhizoplaca peltata* as a parasymbiont. Halıcı & Aksoy (2009) cite *Cercidospora ulothii* upon *Rhizoplaca peltata* from Turkey, a specimen that might also belong here. A thorough screening of the material of *R. peltata* stored in the herbarium GZU did not result in additional findings.

Cercidospora crozalsiana (H. Olivier) Nav.-Ros., Cl. Roux & Casares.

Fig. 2

Cryptogamie, Bryol. Lichénol. 16(2): 100 (1995).

≡ *Sphaeria crozalsiana* H. Olivier, Bull. Acad. Internat. Géogr. Bot. 17: 168 (1907).

≡ *Didymella crozalsiana* (H. Olivier) Vouaux, Bull. Soc. Mycol. France 29: 98 (1913).

Type – [France], “Hérault, à Béziers, sur le *Squamaria lentigera*, [A.] de Crozals“ (PC?, n.v.).

Host species of the type – *Squamaria lentigera* (Weber) Poelt.

Description – Ascomata perithecioid, (160–)200–280 μm diam., exciple blue-green in its upper part and colorless at the base; in the most mature ones sometimes uniformly blue-green throughout, 12–15(–20) μm thick towards its base. Paraphysoids abundant, 1.5–2 μm thick. Asci 85–120 \times 10–14 μm , cylindrical, mostly 4-spored, but not rarely 2-spored. Ascospores (22–)24.5–28.3–32(–37) \times (5–)5.5–6.2–7(–8) μm , with a length/width ratio of (3.2–)3.7–4.6–5.5(–6.8) ($n = 106$), mostly 1-septate, only occasionally simple, colorless, from narrowly ellipsoid-fusiform to almost cylindrical, slightly heteropolar, not or only slightly constricted at the septum, mostly with a clearly visible gelatinous sheath, guttulate. Pycnidiospores bacilliform, 3–5(–8) \times 0.5–1 μm .

Remarks – *Cercidospora crozalsiana* is close to *C. macrospora* and *C. barrenoana* in having 4-spored asci and in the shape and size of the ascospores. However, *C. crozalsiana* differs from the two mentioned species in the intermediate size of its ascospores, larger than those of *C. macrospora* (mostly 20–25 μm long), but smaller than those of *C. barrenoana* (mostly 30–40 μm long). The asci in *C. crozalsiana*, 85–120 μm long, are also among the largest in the genus; this length is only exceeded in the case of *C. barrenoana*, with asci 90–140 μm long. In *C. macrospora*, they are only 65–90 μm long. Comments on the nomenclature and the different criteria applied by several authors for this species are given in Navarro-Rosinés et al. (1995).

Distribution and habitat – *Cercidospora crozalsiana* is known from several Mediterranean localities in the Iberian Peninsula and southern France, mentioned in Navarro-Rosinés et al. (1995), and more recently it has been also reported from Turkey, by Candal & Halıcı (2011). Furthermore we report it here from southern Sweden and the Balcan country Macedonia. Based on our

observations, this species is regarded as a specific parasymbiont of *Squamarina* species, among which we could identify *S. cartilaginea*, *S. lentigera* and *S. stella-petraea*. The two former host species grew on soil, including gypsum-rich soils, while the latter grew on boulders of carbonated sandstone, close to the soil.

Exsiccata examined – Hafellner, Lichenicolous Biota 14 (BR, CANB, GZU, NY, UPS).

Specimens examined – **EUROPE: France:** See Navarro-Rosinés et al. (1995).– **Macedonia:** Scopje, secus viam inter Želino et Grupčin, 280 m, ad saxa calcarea, 6.X.1976, A. Vězda (GZU). On *Squamarina cartilaginea*.– Korab, Tal der Radika bei Kosovrasti Banja E von Debar, SE-exponierte Hänge aus Gips über der Schwefelquelle; 10.VII.1977, J. Hafellner 52501 (herb. Hafellner). On *S. lentigera*.– **Spain:** See also Navarro-Rosinés et al. (1995) and Hafellner & Casares-Porcel (2003).– Aragón, Zaragoza, entre Fuentejalón y Pozuelo de Aragón, lomas yesosas cerca de la carretera, 450 m, 4.IV.1999, J. Etayo (herb. J. Etayo 16970, BCN-lich.). On *S. lentigera*.– **Sweden:** Öland, between Sandviken and Södvik, on alvar ground (calcareous soil), 12.VII.1977, I. Kärnefelt 2710a (GZU). On *S. lentigera*.

Cercidospora epipolytropica (Mudd) Arnold.

Fig. 3–7 k-p

Flora 57:154 (1874).

≡ *Thelidium epipolytropum* Mudd, Man. Brit. Lichens: 298 (1861).

≡ *Verrucaria epipolytropica* (Mudd) Crombie, Lich. Brit.: 121 (1870).

≡ *Pharcidia epipolytropica* (Mudd) Arnold, Flora 53: 236 (1870).

≡ *Didymosphaeria epipolytropica* (Mudd) G. Winter, Rabenh. Krypt.-Fl., Ed. 2, 1(2): 432 (1885).

≡ *Didymella epipolytropica* (Mudd) Berl. & Voglino, Syll. Fung. Add. 1–4: 89 (1886).

≡ *Cyrtidula epipolytropica* (Mudd) Jatta, Syll. Lich. Ital.: 496 (1900).

≡ *Arthopyrenia epipolytropica* (Mudd) H. Olivier, Bull. Int. Acad. Géogr. Bot. 16: 262 (1906).

Type – British Isles: sine loc., on *Lecanora polytropica*, W. Mudd (K 163703, neotype (“lectotypus”) selected by Hawksworth & Diederich 1988).

Loci classici of syntypes – Great Britain, Highlands of Scotland, Admiral Jones; Ayton Moor, Cleveland, W. Mudd (?), both on *Lecanora polytropica*. Cliffrigg near Ayton, Cleveland, W. Mudd (?), on *Lecanora saxicola* as *Squamaria saxicola*.

Host species of the type – *Lecanora polytropica* (Ehrh. in Hoffm.) Rabenh.

Illustrations – Hafellner (1987: 358).

Description – Ascomata preferably immersed in the hymenia of the host, perithecioid, (100–) 130–220 μm diam., globose. Exciple colorless in its lower half, greenish or \pm brownish blue around the ostiole, 10–15 μm thick toward its base. Paraphysoids abundant, 1–1.5 μm thick, only scarcely branched. Asci 50–70 \times 9–13 μm , cylindrical-clavate, mostly 8-spored, rarely only 4- or 6-spored. Ascospores (14–)15–17.3–19(–22) \times (4.5–)5–5.5–6(–7) μm , with a length/width ratio of (2.4–)2.7–3.1–3.8(–4.2) ($n = 99$), 1-septate, very rarely with some simple or 3-septate spores, oval-ellipsoid to slightly fusiform, with both cells similar in size and a median septum, but slightly heteropolar, with the lower cell slightly narrower than the upper one. Pycnidia globose, 100–130 μm . Pycnidiospores colorless, simple, bacilliform, 3–4(–5) \times 0.5–1 μm .

Remarks – *Cercidospora epipolytropica* s. l. is a fungus specific to different taxa of the *Lecanora polytropica* group, and is characterized by having ascospores varying from oval-ellipsoid to fusiform, mostly below 20 μm in length. This size is coincident with the values given by other authors on the same hosts (Hafellner 1987, Vainio 1921).

Setting aside the size of the ascospores, there are a number of constant differences among the different specimens of *C. epipolytropica* s. l. studied. The most striking one is the number of ascospores per ascus, 4 or 8, as the case may be; this difference seems to be associated with variations in the size of asci and ascomata, and also with host characteristics. 8-spored specimens grow mainly on typical *Lecanora polytropica*, proceeding from localities at relatively high altitudes.

On the contrary, the samples of *Cercidospora* with 4-spored asci come from localities at lower altitudes, and grow mostly on a taxon of the *L. polytropa* group which fits the features of *L. stenotropae* Nyl. (according to Clauzade & Roux 1985, Purvis et al. 1992, Wirth 1995).

In this study, the specimens with 4-spored asci are separated into a provisional species, *Cercidospora stenotropae*, pending the availability of more *Cercidospora* material growing on the *L. polytropa* group. The examination of more material would allow us to determine the characteristics and variability of these fungi more exactly, and have a better knowledge of their distribution, and clearer differentiation of their hosts.

In the original description of *Thelidium epipolytropum*, Mudd (1861) applied a wider concept of this taxon which would include both *Cercidospora epipolytropae* s. str. and *C. macrospora* as currently delimited as he reported specimens growing on *Lecanora polytropae* and on *Lecanora saxicola* (sub *Squamaria saxicola*). Specimens growing on *L. saxicola* and possibly constituting paratype material were distributed in an exsiccatum by itself (Mudd, Lich. Brit. Exs. 287). A sample of it was revised as *Cercidospora macrospora* (see below). The neotype (“lectotypus”) of *Thelidium epipolytropum* was selected by Hawksworth & Diederich (1988) from a specimen on *Lecanora polytropae* collected by W. Mudd from an unknown locality. This type material is characterized by having 8-spored asci and other features fitting our concept of *C. epipolytropae* s. str.

There are also reports of *C. epipolytropae* upon the thallus of *Lecanora geophila*, a terricolous species with a secondary chemistry similar to that of *Lecanora polytropae*. Such material originating from western Siberia has been distributed by Santesson, Fungi Lichenicoli exs. 257, accompanied by a note on the label that in this strain 4-spored and 8-spored asci should be equally frequent and the ascospores being 16–18 × 5–7 μm (Santesson 1998). The strain has also been reported from Greenland inhabiting even the type specimen of the host lichen (Obermayer & Kantvilas 2003). It needs to be further studied as are other records of *C. epipolytropae* on single specimens of *Lecanora baicalensis* and *L. chondroderma* (Poelt & Grube 1993).

Furthermore, *C. epipolytropae* has also been mentioned as a parasite of *Rhizoplaca melanophthalma* (Navarro-Rosinés & Hladun 1987, Alstrup & Hawksworth 1990). However, the specimens growing on this host differ from the ones associated with *Lecanora polytropae* group by having larger ascomata and slightly longer, ellipsoid-fusiform ascospores. In this work, they are separated into a new species: *C. melanophthalmae*.

Distribution and habitat – *Cercidospora epipolytropae* is a taxon widely distributed in the Northern Hemisphere, profusely cited in Europe, North America (Hafellner 1987, Triebel et al. 1991). Records from Asia (apart from Siberia, see Zhurbenko 2007) and Africa are still few. After our observations, this species may be regarded as a parasymbiont (although its ascomata are also developed in the hymenia of the host lichens) of *Lecanora polytropae* s. str., *L. polytropae* var. *alpigena*, *L. intricata* and other taxa of this group dwelling in northern territories and in high mountains. In fact, *C. epipolytropae* is the lichenicolous fungus holding the altitude record on earth. It has been reported together with its typical host from Makalu in the Himalaya range at 7400 m s. m. (Hafellner 1987).

Exsiccata examined – Hafellner, Lichenicolous Biota 32 (BR, CANB, GZU, NY, UPS).– Räsänen, Lichenes Fenniae Exs. 700 (GZU).– Santesson, Fungi Lichenicoli Exs. 157 (GZU and herb. P. Diederich).

Selected specimens examined – (on *Lecanora polytropae* if not otherwise stated).

EUROPE: Austria: Kärnten, Hohe Tauern, Kreuzeck-Gruppe, Hänge oberhalb der Turgger Alm gegen die Schwarzsteinwände, Grünschiefer, 46°44'N/13°09'E, 2000–2100 m, GF 9244/2, 24.VII.1994, J. Poelt (GZU).– Kärnten, Klagenfurter Becken, Kreuzberg bei Klagenfurt, IX.1973, J. Poelt (GZU).– Niederösterreich, Waldviertel, große Granitfelsen ca. 1,4 km W Pretrobruck, ca. 820 m, GF 7555/2, 7.IV.1994, J. Poelt & R. Türk (GZU).– Steiermark, Schladminger Tauern, NW-Abhänge des Säulecks im Sattental, S von Gröbming, am oberen Ende des Schneetalrückens, Schieferschrofen, ca. 2150 m, 3.IV.1985, J. Hafellner 13025 (GZU).– Steiermark, Niedere Tauern, Wölzr Tauern, Eselsberggraben NW von Oberwölz, ca. 1 km SE der Neunkirchner Hütte,

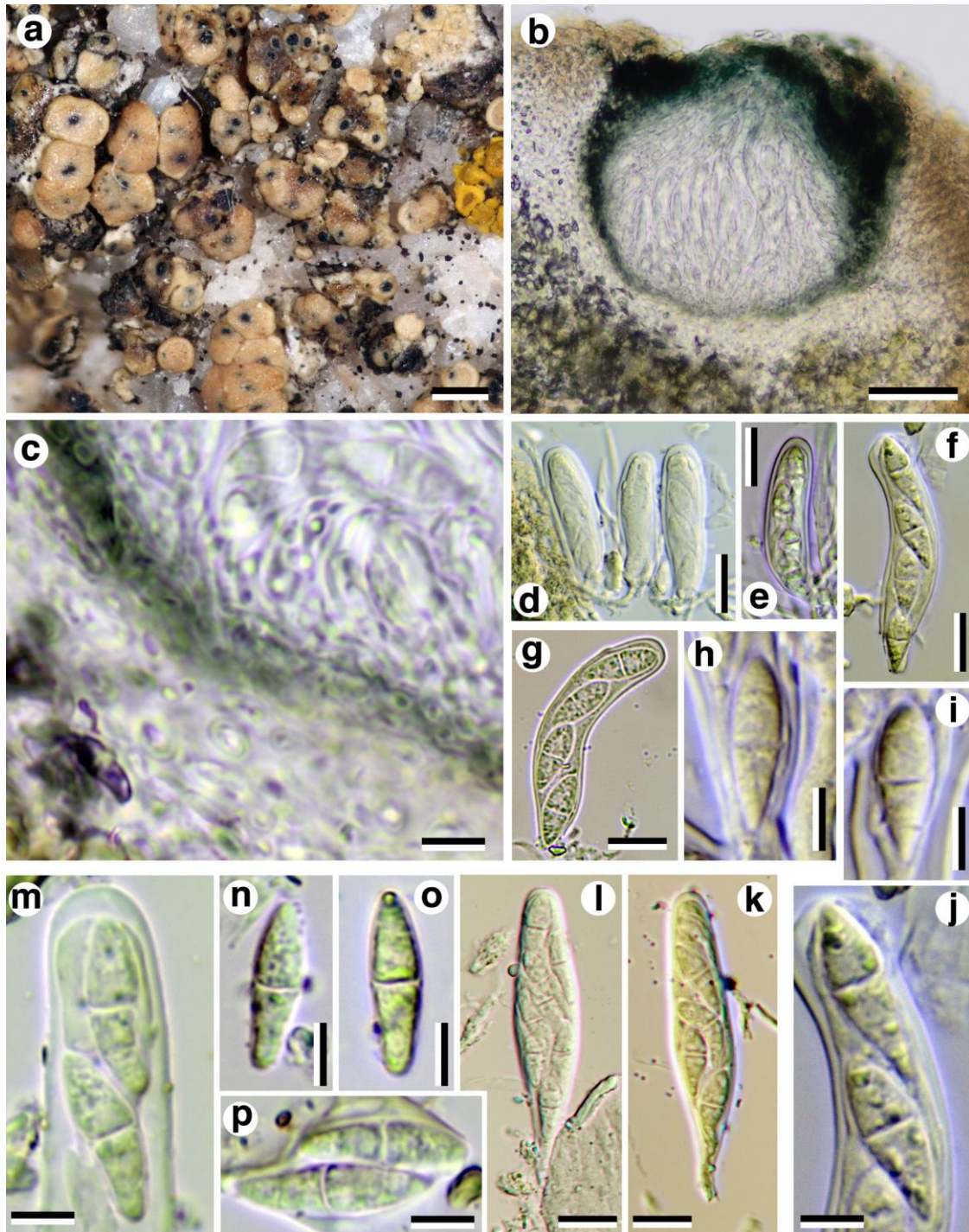


Fig. 7 – a–j *Cercidospora stenotropa* (Soria, Spain, VAB 7726). a superficial aspect of a parasitized thallus of *Lecanora* gr. *polytropa*, with the fungal ascomata immersed in the lichen apothecia. b detail of the ascoma in vertical section. c detail of the exciple in vertical section from the basal part of the ascoma. d–e immature asci f–g mature asci. h–j ascospores. k–p *Cercidospora epipolytropa* (Apache, Arizona, USA, ASU-Nash 11763). k–l immature asci. m–p ascospores. – Bars: a = 0.2 mm; b = 50 μ m; d–g, k–l = 10 μ m; h–j m–p = 5 μ m.

[47°16'15''N/14°09'30''E], ca. 1510 m, GF 8750/2, teilweise eisenhaltige Glimmerschieferblöcke, 22.V.1988, J. Hafellner 20850 & A. Hafellner (GZU).– Steiermark, Seetaler Alpen, W- Abhang 5 km E von Neumarkt, Oberberg, 200 m unter dem Gehöft Schweintaler, 1250 m (GF 8952/2), offene Waldweide, Felsblöcke, 20.III. 1987, W. Obermayer 1934 (GZU). On *Lecanora intricata*.–

Steiermark, Joglland, N Schloss Herberstein, unterste N- und W-seitige Abbrüche des Buchberges gegen den Stubenbergsee bzw. die Feistritz, 400–420 m, 6.XI.1988, J. Poelt (GZU).– Steiermark, Steirisches Randgebirge („Cetische Alpen“), Wechsel, an der Bergstraße von Mönichwald zum Wechsel, am Wiesenhang oberhalb vom Spitzbauer, ca. 1000 m, GF 8561, Lesesteinhaufen, 8.IX.1989, J. Poelt (GZU).– Tirol, Ötztaler Alpen, Ötztal, 3 km SSE von Obergurgl, E der Brücke über den Gaisbergtal-Bach, 2300–2400 m, 30.VIII.1993, J. Poelt (GZU). On *L. polytropa* var. *alpigena*.– Tirol, Osttirol, Nationalpark Hohe Tauern, Glockner-Gruppe, Ködnitztal NE ober Kals, kurz N ober der Lucknerhütte, 47°02'35''N/12°41'30''E, ca. 2300 m, GF 8942/3, niedere Kalkschieferschrofen und Rasen am Westhang, Lesesteinmauer, auf Glimmerschiefer, 4.IX.1998, J. Hafellner 46861 (GZU).– See also Hafellner (1987).– **France**: Dept. Puy-de-Dôme: Auvergne, monts Dore, puy de Sancy, Andesitschrofen auf der Nordseite, ca. 1820 m, 31.VII.1980, A. Bellemère & J. Hafellner 9550 (GZU).– Dept. Cantal: Auvergne, monts du Cantal, puy Mary, am Steig vom Pas de Peyrol zum Gipfel, ca. 1680 m; NW-exponierte Andesitblöcke, 30.VII.1980, A. Bellemère & J. Hafellner 9421 (GZU).– See also Hafellner (1987).– **Germany**: See Hafellner (1987).– **Italy**: Südtirol, Zentralalpen, Ötztaler Alpen, Weißseejoch N von Melag im Langtauferertal, [46°52'00''N/10°41'25''E], 2960 m, Schiefer, 21.IV.1984, J. Hafellner 12455 (GZU).– See also Hafellner (1987).– **Norway**: Hordaland, Gem. Voss, S-exp. Hänge N des Sees Hamlagrövatnet, ca. 25 km SW von Voss, ca. 800 m, niedere Felshöcker aus Schiefer an der Obergrenze des Birkenwaldes, 20.VIII.1984, J. Hafellner 12107, 12190 & A. Ochsenhofer (GZU).– See also Hafellner (1987).– **Slovakia**: Niedere Tatra, oberhalb Špania Dolina, 740–770 m, Abraumhalde der alten Kupfermine, 1.VII.1993, I. Pišút & J. Poelt (GZU, under *L. polytropa*).– **Spain**: Aragón, prov. Huesca, Anielarra, Campa de la Contienda, 1700 m, 19.VII.1973, X. Llimona (BCN-lich 2546, in *L. polytropa*).– See also Hafellner (1987).– **Sweden**: Vätergötland, par. Partille to the north, on boulder, 23.V.1919, H. Magnusson, Swedish Lichens n. 2469 (MARSSJ).– See also Hafellner (1987).– **Switzerland**: See Hafellner (1987).– **United Kingdom**: Isle of Skye, S Carbost, Glen Brittle Hut, NG 41 21, on rocks, 28.V.1987, P. Diederich 9109 (herb. P. Diederich).– Isle of Skye, NE Uig, Quiraing, NG 44 68, on rocks, 24.V.1987, P. Diederich 8204 (herb. P. Diederich).

ASIA: Japan, Hokkaido, Prov. Ishikari: beside the trail between Bohgakudai and Fukiage Spa, 43°26'N/142°39'E, elev. ca. 1090 m, on rocks, 10.VIII.2006, A. Shimizu, separated from Kashiwadani, Lich. Minus Cogniti exs. 333) (GZU).– **Nepal**: See Hafellner (1987).

AFRICA: Canary Islands, Tenerife, an der Straße von La Orotava nach El Portillo, kurz unter El Portillo, [28°18'40''N/16°34'W], ca. 1950 m, N-exponierte Vulkanitschrofen im lichten *Pinus canariensis*-Wald, 17.II.1989, J. Hafellner 32884 & A. Hafellner (GZU).

NORTH AMERICA: U.S.A: Arizona, Apache Co., Escudilla Mountain, north of Alpine, spruce-fir community, on volcanic rock, 10.500', 30.VIII.1975, T.H. Nash 11763 (ASU).– Arizona, Apache Co., Mount Baldy Wilderness, near the beginning of Trail No. 95, from Phelp's Cabin to Mount Baldy, above the East Fork of the Little Colorado River, 33°56' N/109°30'W, alt. 2960 m, spruce-fir forest, on acidic rock, 9.VI.1998, T. H. Nash III 41983 = Lich. exs. Arizona State Univ. 317 (GZU, under the name of the host).– California, Tulare, Sierra Nevada, Sequoia National Park, SE of Giant Forest, Mineral King, Eagle Crest Trail, NE exposed schist outcrops, with mature *Juniperus*, 2383 m, 118°35.7'W; 36°26.9'N, P. & B. v.d.Boom (herb. Boom 29040).

Cercidospora macrospora (Uloth) Hafellner & Nav.-Ros.,

Fig. 5–8

Lichen Flora of the Greater Sonoran Desert Region, Volume 2: 638 (2004).

≡ *Phacopsis macrospora* Uloth, Flora 44: 653 (1861).

Type – [Germany], „parasitisch auf dem Laub von *Placodium saxicolum* auf Ziegeldächern auf den Gradirbauten bei Nauheim“, W. Uloth (? , n. v.).

= *Cercidospora ulothii* Körb., Parerga lich.: 466 (1865).

= *Didymella ulothii* (Körb.) Berl. & Voglino, Syll. Fung. Add. 1–4: 89 (1886).

Type – [Germany], „auf dem Thallus von *Placodium saxicolum*, ... bei Nauheim in Kurhessen“, [W.] Uloth (? , n. v.).

? = *Sphaeria crozalsiana* var. *saxicolae* H. Olivier, Princip. Paras. Lich., Suppl. 1: 15 (1907).

Type – France, “Sur *Squamaria saxicola* à Roquehaute dans l’Hérault”, De Crozals (? n. v.).

Host species of the types – *Lecanora saxicola* (Pollich) Ach. (syn. *Lecanora muralis* sensu auct., *Protoparmeliopsis muralis* sensu auct.).

Illustrations – Hafellner (1987: 356), as *C. ulothii*.

Description – Lichenicolous fungus with the ascomata immersed in the host thallus and apothecial discs, producing, in some cases, deformations in the form of convex cecidia (observed in some specimens of *Lecanora versicolor*). Ascomata perithecioid, 150–250 µm diam. Exciple colorless or slightly green-blue in its lower half, intensely green-blue around the ostiole, 10–15(–20) µm thick towards its base. Paraphysoids scarcely abundant, 1.5(–2) µm thick. Asci (55–)65–90 × 9–11 µm, cylindrical, 4-spored, exceptionally 8-spored. Ascospores (19–)20–22.9–25(–30) × 4–5.1–6(–7) µm, with a length/width ratio of (3.0–)3.8–4.5–5.4(–6.7) ($n = 179$), 1-septate, narrowly ellipsoid or fusiform, with both cells equal in shape and size, with the septum median, more rarely slightly heteropolar.

Remarks – *Cercidospora macrospora* is a species characterized by having predominantly 4-spored asci and ascospores with a length mostly of 20–25 µm. Similar 4-spored asci also occur in *C. barrenoana* and *C. crozalsiana*, but in these species the size of the ascospores is clearly larger (see also the comments on these species). *C. stenotropae* also has 4-spored asci, but its ascospores measure only 16–21 µm in length, being smaller than those of *C. macrospora*.

For the synonymy of *C. ulothii* in *C. macrospora* see Navarro-Rosinés et al. (2004). According to Santesson (1960), both taxa were described on the basis of material likely to come from the same collection. Taking this into account and also considering that they were described on the same host, there is little doubt about their synonymy. Hence, the second name has priority over the well-known former one.

Other than *Cercidospora epipolytropa*, *C. macrospora* does not show a preference to develop the ascomata in the apothecial discs. Ascomata are equally frequent in host thallus and apothecia.

Distribution and habitat – *Cercidospora macrospora* is considered a holarctic taxon (Hafellner 1987). Previously this species has been reported most frequently under its synonym, *C. ulothii*. Most records are from Europe, temperate Asia, the Mediterranean and Macaronesian regions of Africa, and North America. Typically, it is associated with taxa of *Lecanora saxicola* group (i. e., the *Lecanora muralis* sensu auct. group or *Protoparmeliopsis* spp.), growing both on siliceous and calcareous substrata. Hosts that we have identified for *C. macrospora* include *Lecanora bolcana*, *L. dubyi* (= *L. muralis* subsp. *dubyi*), *L. garovaglii*, *L. cf. nevadensis*, *L. novomexicana*, *L. phaedrophthalma* var. *christoi*, *L. saxicola* (= *L. muralis* sensu auct., fide Laundon 2010) and *L. versicolor*.

Arup & Grube (1999) and Pérez-Ortega et al. (2007) confirmed phylogenetically that *Lecanora garovaglii* is sister to *Lecanora saxicola*, although the former find *L. novomexicana* and *L. phaedrophthalma* more closely related to *Rhizoplaca melanophthalma* than to *L. saxicola*. It would be necessary to confirm these hosts, with the study of more specimens of *C. macrospora* on *L. novomexicana* and *L. phaedrophthalma*.

Although relatively rare, *C. macrospora* can be locally abundant, as in locality of Aragón cited below where it covered important extensions of the thalli of *L. versicolor* growing on horizontal carbonated sandstone surfaces. Citations of *C. macrospora* (or *C. ulothii*) on hosts other than the *L. saxicola* group most likely belong to other taxa (see also under *C. barrenoana* and *C. melanophthalmae*).

Exsiccata examined – Hafellner, Lichenicolous Biota 134 (BR, CANB, GZU, NY, UPS).– Kunze, Fungi Selecti Exs. 78 (GZU).– Santesson, Fungi Lichenicoli Exs. 203 (GZU), 258 (GZU and herb. P. Diederich).– Triebel, Microfungi Exs. 181 (GZU).

Selected specimens examined – (on *Lecanora saxicola* var. *saxicola* unless otherwise cited).

EUROPE: Albania, Northern Albania, Shkodër distr., Shkodër, Rozafa (hill of the castle) 42°02'30''N/19°29'30''E, c. 100 m; limestone, on rock outcrops, 11.IV.2001, L. Kashta, herb. Hafellner 54902 (GZU).– **Austria**: Kärnten, Nationalpark Hohe Tauern, Glockner-Gruppe, S Hänge des Fuscherkar Kopfes, N ober der Hofmannshütte, [47°05'10''N/12°44'20''E], ca. 2500 m, GF 8942/1, Kieselkalkblöcke, 21.IX.1988, J. Hafellner 32052, M. Walther & A. Hafellner (herb. Hafellner). On *L. dubyi*.– Steiermark, Niedere Tauern, Triebener Tauern S von Trieben, Großer Gießstein, N-Hänge, Felswände N ober dem Eberlsee, 47°24'05''N/14°32'25''E, c. 1700 m, GF 8553/3, SE-exponierte Felsabbrüche eines quarzreichen Silikatgesteins mit Spuren von Karbonat, auf Steilflächen am Fuß der Abbrüche, 15.VIII.2000, J. Hafellner 52170 (GZU).– Tirol, Paznaun, Fimbatal, nahe dem Ghf Bodenalpe, IX.1960, A. Schröppel (GZU). On *L. dubyi*.– See also Hafellner (1987).– **France**, Dept. Hautes-Alpes (05), entre le Lautaret et le Galibier, versant S de la crête de Chailloll, 2320 m, sur schistes à peigne calcaires, 80°S, in Acarosporetum badiofuscae, 28.VIII.1972, C. Roux (MARSSJ). On *L. saxicola* agg.– Dept. Hautes-Alpes, col de Granon, NNW von Briancon, 2250–2400 m, Gneisfelsen, 11.VII.1970, J. Poelt 8571 (GZU, under the name of the host). On *L. dubyi*.– **Germany**, Reinland, Eifel, Schotterhang zwischen Mechernich und Dattel, VIII.1978, B. Feige (GZU).– Sachsen-Anhalt, W von Eisleben, Kupferschieferhalde zwischen F 80 und Saugrund, 11.XI.1990, S. Huneck (GZU).– **Greece**: Makedonien, Vermion Gebirge, zwischen Veria und Kozani oberhalb der Quelle Zoodochon pighi, alt. 1500 m, 22.VII.1973, H. Pittoni (GZU).– Voiotia, Bergrücken SE der Ortschaft Tsoukalades, N der Straße von Livadia nach Arahova, alt. ca. 500 m, 16.IX.1989, H. Mayrhofer 16314 (GZU). On *L. dubyi*.– **Italy**: Trentino-Alto Adige, Südtirol/prov. Bolzano, Vinschgau, Trockenhang bei Laas, alt. ca. 870 m, 10.X.1953, A. Schröppel (GZU). On *Lecanora garovaglii*.– Trentino, Südtiroler Dolomiten, Porto Vescovo S von Arabba, Felszacken kurz E über der Bergstation der Seilbahn, ca. 2400 m, 46°28'N/11°53'E, S-exponierte Abbrüche, 16.IV.1979, J. Hafellner 4595 (herb. Hafellner). On *L. dubyi*.– Trentino, Val di Fiemme, beim Rif. Salanzada S von Cavalese, [46°16'30''N/11°27'15''E], ca. 1050 m; S-exponierte Silikatschrofen; 27.X.1984, J. Hafellner 11891 (herb. Hafellner). On *L. garovaglii*.– Emilia-Romagna, Prov. Parma, nördlicher Apennin, an der Straße über den [ca. 13 km NE vom] Pso. della Cisa, Mte. Prinzera am N Ortsende von Boschi di Bardone, [44°33'20''N/10°02'10''E], ca. 850 m, Serpentin, SW-exponierte Abbrüche, 29.X.1978, J. Hafellner 4380 (GZU). On *L. dubyi*.– **Macedonia**: Babuna, Paß Pletvar E von Prilep, 41°22'20''N/21°39'55''E, ca. 1200 m, S-exponierte Hänge mit einzelnen großen Silikatblöcken, 11.VII.1977, J. Hafellner 41727 (herb. Hafellner). On *L. garovaglii*.– See also Hafellner (1987).– **Netherlands** (Limburg), Maastricht, stadsmuur bij de hoek van de Nieuwenhofstraat, vestingmuur, km blok 61-28-32, coord. 176.2/317.2, sur un mur en briques, 10.V.1998, P. Diederich 13652 (herb. P. Diederich).– **Romania**, Dobrogea, Distr. Tulcea, in valle rivi Tirusor, prope pagum Tirusor, 50 m, 12.VII.1973, A. Vězda. (MARSSJ, A. Vězda: Lichenes selecti exsiccati 1298). On *L. versicolor*.– **Slovakia**, Súľovské skaly, Strážovské vrchy NE von Považska Bystrica, kalkreiche Konglomeratfelsen N vom Dorf Súľov, 400–600 m, 19.IV.1986, J. Poelt (GZU).– **Spain**: Aragón, prov. Zaragoza, Escatrón, Mocatero, U.T.M. 30TYL27-YL37, 190 m, 17.X.1991, P. Navarro-Rosinés (BC). On *L. versicolor*.– Prov. Zaragoza, am Nordufer des Embalse de Mequinensa N von Caspe, c. 200 m, Triften mit Kalksandsteinblöcken, 25.V.1983, J. Poelt (GZU).– Cantabria: Invernales de Liébana, calizas expuestas, J. Etayo (herb. J. Etayo). On *L. versicolor*.– Castilla-La Mancha: prov. Cuenca, Talayuelas, Pico Ranera, U.T.M. 30SXX4408, arenisca, 1400 m, 8.XI.1991, V. Calatayud (VAB-lich. 7446). On *Lecanora bolcana*.– Castilla y León: prov. Avila, Sierra de Gredos, cerca de Zapardiel de la Ribera, sobre granito, 1000 m, 16.III.1997, V. Calatayud (VAB-lich. 7765). On *L. bolcana*.– Catalunya: prov. Girona, Alt Empordà, el Port de la Selva, Salt de la Gorga (Cap de Creus), U.T.M. 31TEG1883, 150 m, 4.I.1985, X. Llimona (BCN-lich. 5546).– Comunitat Valenciana: prov. Castelló, Azuebar, Bco. Mosquera, U.T.M. 30SYK2519, arenisca, 660 m, 26.X.1990, V. Calatayud (VAB-lich. 7445).– Prov. Castelló, Toro, Bco. Rasinero, U.T.M. 30SXX9122, arenisca, 880 m, 16.V.1992, V. Calatayud (VAB-lich. 7444 and herb. P. Diederich).– Andalucía: Prov. Almería, Sierra Alhamilla NE von Almería, Trockenhänge etwa 4 km S von Lucainena de las Torres, N von Níjar, alt. ca. 600 m, 7.IV.1979, A. Buschardt (GZU).– See also

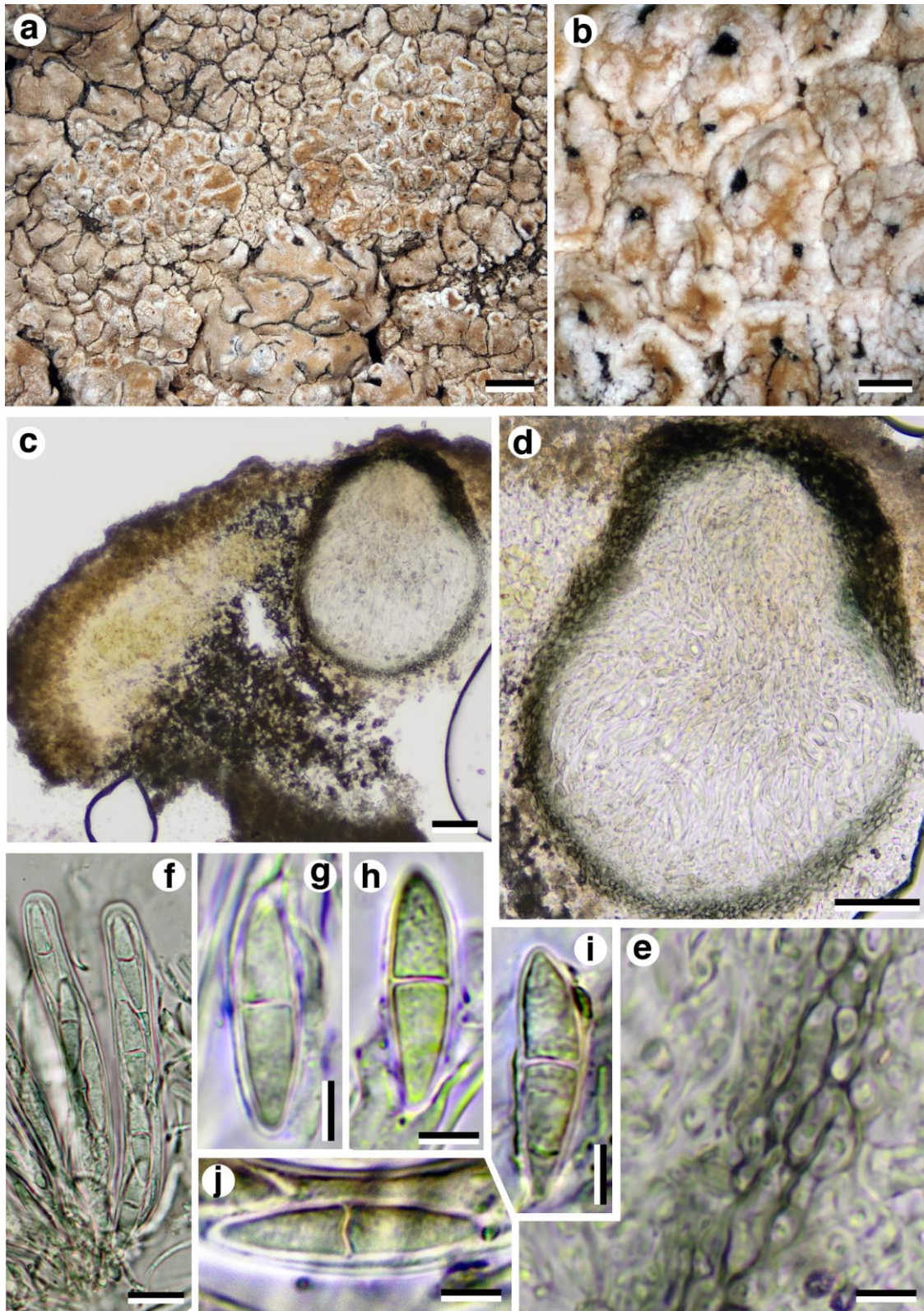


Fig 8 – a-j, *Cercidospora macrospora* (Escatrón, Aragón, Spain). **a**, superficial aspect of parasitized thallus of *Lecanora versicolor*, with deformations induced by the fungus in the form of convex excidia. **b**, Detail of the superficial appearance of the fungal ascomata immersed in the lichen thallus. **c**, vertical section with a fungal ascoma immersed in the lichen thallus. **d**, detail of the ascoma in vertical section. **e**, detail of the exciple in vertical section from the lateral part of the ascoma. **f**, asci. **g-j**, ascospores. Bars: **a** = 1 mm; **b** = 0.2 mm; **c**, **d** = 50 μm ; **f** = 10 μm ; **e**, **g-j** = 5 μm

Hafellner (1987).— **Sweden**, Uppland, Österlövsta par., Lövstabruk ca. 5 km SE of Österlövsta, just W of the village, 16°24'30''N/17°57'30''E, alt. ca. 25 m; mixed forest with granitic outcrops; on old tiles beside the road, 11.V.1996, J. Hafellner (GZU).— **United Kingdom**: England, North Yorkshire, Cleveland, Ayton (near), Cliffrigg, sine data, W. Mudd (K 163704; Mudd, Lich. Brit. Exs. 287, possibly paratype material of *Thelidium epipolytropum*, at least from paratype locality).— See also Hafellner (1987).—

ASIA: Afghanistan: Prov. Kabul, Paghman Gebirge, oberhalb des Ortes Paghman, an der Talgabelung Chap-Darrah und Rast-Darrah, 34°37'N/68°56'E, alt. 2550 m, Silikatfelsen an der rechten Talseite, 21.VI.1970, M. Steiner Ste 59/13a (GZU). On *L. dubyi*.— Prov. Paktia, 10 km NE of Khost, an der Straße nach Yaqubi, 23°30'N/69°58'E, alt. 1170 m, N-seitig an einer Felsrippe aus Vulkanit in der Schotterebene, 3.VII.1970, M. Steiner Ste 70/1a (GZU).— **Japan**, Hokkaido, Shani-Sando, Esashi-gun, on cliffs along the coast, 17.VIII.1970, S. Kurokawa 70818a (separated from Kurokawa, Lich. Rar. Crit. exs. 225) (GZU).— **Nepal**, Central Himalaya, Langtang Area, Langshisa, 4100–4200 m, on big rocks, 15.IX.1986, J. Poelt N86-1733 (GZU, under the name of the host). — **Pakistan**: Hindukush, S des Zani Passes, 2700 m, 3.VIII.1993, T. Peer (GZU, under the name of the host). On *L. dubyi*.— Baltistan, Northwestern Himalaya, eastern Deosai Plateau, 35°05'N/75°34'E, 4100–4200 m, rocky slope, 15.VII.1991, J. Poelt (GZU). On *L. dubyi*.— Baltistan, Karakorum, Haramosh Range, Chogo Lungma Valley, Gon E of Arandu, 35°53'N/75°22'E, 3000–3200 m, 9.VIII.1991, J. Poelt (GZU). On *L. dubyi*.— Karakorum, Upper Kaghan Valley, Saiphul, Muluk, on the crest, 34°50'N/73°40'E, 3900 m, 16.VII.1990, G. Miehe & S. Miehe 365a (GZU). On *L. dubyi*.— Northwestern Himalaya, Indus Valley, rockery ca. 2 km W of Chilas, alt. c. 1300 m, 21.VII.1991, J. Poelt K91-805 (GZU).— **Russia**: Yakutia, Mosmkii region, along the river Indigirka, c. 6 km SE of Tyubelyakh, 65°19'N/143°15'E, 800 m, 16.VII.1992, M.P. Zhurbenko 92297 (herb. P. Diederich). On terricolous "*Placolecanora*" sp.—

AFRICA: Canary Isles: Tenerife, Las Cañadas, Boca de Tauce, northwest base of El Sombbrero, alt. 2000 m, 28.I.1964, H. A. Imshaug 34954a (GZU).— Tenerife, Las Cañadas, ca. 0,5 km W der Grenze des Nationalparks W ober El Portillo, 28°17'10''N/16°34'10''W, c. 2100 m, Felsköpfe aus vulkanischem Gestein, 20.II.1989, J. Hafellner 32868 & A. Hafellner (GZU).— Tenerife, Cumbre Dorsal, Izaña, sanft SE-geneigte Hänge zwischen dem Observatorio Meteorológico und dem Observatorio Astronómico, 28°18'10''N/16°30'15''W, c. 2350 m, kleine Vulkanitschrofen in einem *Spartocytisus supranubius*-Bestand, NE-seitig auf kleinen Vulkanitschrofen, 28.IV.2005, J. Hafellner 64313 (GZU).— Gran Canaria: N-Abhänge des Roque Ventaiga W ober Tejada, 27°59'20''N/15°39'W, c. 1150 m, große Vulkanitblöcke in einem Mandelbaumhain, auf zeitweise besonnten Neigungsflächen, 22.II.1994, J. Hafellner 32858 (GZU). On *L. garovaglii*.— **Morocco**: Anti-Atlas, Tizi Aferni 1600 m, sur quartzites, 8.V.1935, R.G. Werner (BC, herb. Werner). On *L. garovaglii*.— Bled Touloum dans les Ida n'Zal, sur calcaire, 8.V.1935, R.G. Werner (BC, herb. Werner). On *L. versicolor*.— Monts Zaians bled(?) Teld, Ass A., terricole entre les pierres mobiles, 5.VI.1931, J. Gattefossé (BC, herb. Werner). On *L. versicolor* (kept at Werner's herbarium, and labeled as *Squamarina periculosa*).

NORTH AMERICA: Canada, Alberta, E side of Alberta Hwy 6, 15.5 miles N of Twin Buttes, 2 miles S of Pincher Creek, 49°23'N/113°55'W, 1220 m, on exposed sandstone, 27.VII.1985, B. D. Ryan 14000a (GZU).— Ibid., B. D. Ryan 13939, 13948 (GZU). On *L. garovaglii*.— **Mexico**. See Hafellner (1987).— **U.S.A**: Arizona, Apache Co., along route 666 23,5 km N of St. Johns, shrubland with scattered junipers, 34°49'0''N/109°14' 15''W, 1860 m, 13.VII.1997, T.H. Nash III 40279 (ASU). On *L. garovaglii*.— Arizona, Apache Co., W end of Querino Wash, just S of Interstate Hwy 40, 6 mi W of Houck, 35°14'N/109°16'W, 1900 m, S-facing, *Juniperus* community, III.1986, B. Ryan 19172 (ASU).— California, Kern Co., S side of California Hwy 178, 1 mile W of Onyx, 35°40'30''N/118°14'30''W, 915 m, 9.VI.1985, B. D. Ryan 15696 (GZU, under the name of the host). On *L. dubyi*.— Colorado, Garfield Co., E side of Hwy 13m, 4.5 mi N of Rifle, 42°17'N, 120°45' 30''W, 1700 m., Pinyon-Juniper / Sagebrush community, S-facing hill, on sandstone, VIII. 1985, B. Ryan 20682 (ASU). On *Lecanora novomexicana*.— Michigan, Keweenaw Co., Isle Royale National Park, Pasage Island at NE tip on rock shore, 9.VII.1983, C. M. Wetmore 47525a (GZU).—

Nevada, Lincoln Co., S end of Pahrnagat Mts., along Hwy 93, ca. 16 miles S of Alamo, 37°15'N/115°W, elev. ca. 950 m, I.1986, B. D. Ryan 15738a (GZU).– Nevada, W of Las Vegas, Red Rock Canyon National Conservation Area, 1290 m, 36°9'43''N/115°27'2''W, on non-calcareous sandstone rocks in an old quarry, 23.XII.1997, P. Diederich 14167 (herb. P. Diederich).– Nevada, Washoe Co., E side of Pyramid Lake, road to the “Pyramid”, 39°56-57'N/119°25-27'W, 25.VI.1985, B.D. Ryan (GZU). On *L. cf. nevadensis*.– New Mexico, San Juan, G1, 36°50'N/109°06'W, 6000', on sandstone, 4.VII.1974, J. Marsh & D. Rankert (ASU).– New Mexico, Santa Fe Co., 19 km NNW of White Lakes along US 285, 35°22'N/105°51'W, alt. 1890 m, on sandstone, 14.X.1983, T.H. Nash 22428a (GZU). On *L. novomexicana*.– Oregon, Lake Co., 5 mi E of Quartz Mountain, Drews Creek, Oregon Hwy 140, 42°17'N/120°45'30''W, 1585 m., pine forest, on basalt, 28.VI.1985, B. Ryan 13856 (ASU). On *L. phaedrophthalma* var. *christoi*.

***Cercidospora melanophthalmae* Nav.-Ros., Calat. & Hafellner, sp. nov.**

Fig. 6, 9 f-l.

MycoBank 516549

Ascomata perithecioidea, totaliter immersa in thallis aut apotheciis hospitis. In sectione transversali pseudothecia globosa, 170–330 μm in diametro. Paries ascomatum apicaliter viridulo-caerulescens, in externa parte leviter fusco-violascens, parce incrassatus, basaliter subhyalinus, circa 10–15 μm crassus. Paraphysoides copiosae, 1–1.5(–2) μm crassae. Asci cylindrici vel subclavati, (55–)70–90(–100) μm longi et 10–15 μm lati, octospori, rare hexaspori aut quadrispori. Ascosporae (16–)18–22(–24) \times (4–)5–6.5(–7) μm magnae, incoloratae, ellipsoidei-fusifformes, ad septum non aut parum constrictae, cellula superiore brevior crassioreque quam cellula inferior, tenuiter halonatae. *Cercidosporae epipolytropae* affinis, sed ei dissimilis pseudotheciis et ascosporis majoribus. Supra thallis *Rhizoplacae melanophthalmae* vigens.

Type – Spain, Catalonia, prov. Girona, Baixà Cerdanya, Meranges, prop del refugi de Malniu, U.T.M.31TCH9902-DH0002, 2200 m, 13.X.1991, X. Llimona & J.M. Pérez-Redondo (BCN-lich., holotype).

Host species of the type – *Rhizoplaca melanophthalma* (Ramond) Leuckert & Poelt

Etymology – The specific epithet refers to the host species, *Rhizoplaca melanophthalma*.

Description – Ascomata perithecioid, 170–330 μm in diam., exciple blue-green in its upper part, sometimes violaceous brown in the outermost part, colorless towards its base, 10–15 μm thick in this part. Paraphysoids abundant, 1–1.5(–2) μm thick. Asci (55–)70–90(–100) \times 10–15 μm , cylindrical-clavate, with (4–6–)8 spores. Ascospores (16–)18–19.7–22(–24) \times (4–)5–5.7–6.5(–7) μm with a length/width ratio of (2.4–)2.9–3.5–4.2(–4.8) ($n = 149$), 1-septate, rarely simple, colorless, mostly ellipsoid-fusiform and attenuated at both extremes, less frequently oval-ellipsoid and only attenuated at one of the apices, slightly heteropolar, not or slightly constricted at the septum, guttulate.

Remarks – The occurrence of specimens of *Cercidospora* on *Rhizoplaca melanophthalma* has already been mentioned by other authors (Werner 1937, Navarro-Rosinés & Hladun 1987, Alstrup & Hawksworth 1990), who included them in a wider concept of *C. epipolytropha*. *C. melanophthalmae* and *C. epipolytropha* are the only two species in this study characterized by having predominantly 8-spored asci. Mature asci with only six or four ascospores may occur but are always rare among typical ones and contain usually aborted additional spores with smashed walls. Both taxa differ in the size of their ascomata, asci and ascospores, which are larger in *C. melanophthalmae*. The shape of the ascospores is also somewhat different; while in *C. melanophthalmae* they are mostly ellipsoid-fusiform, in *C. epipolytropha* they are oval-ellipsoid, with the upper apex rounded and the lower one slightly attenuated.

Other than *Cercidospora epipolytropha*, *C. melanophthalmae* does not show a preference to develop the ascomata in the apothecial discs. Ascomata are equally frequent in host thallus and apothecia but are more conspicuous in the later.

Distribution and habitat – *Cercidospora melanophthalmae* seems to be a specific parasymbiont of *Rhizoplaca melanophthalma*, and is known with certainty from the localities in the

mountains of southern Norway, the French Alps, the French and Spanish Pyrenees, Corsica, the Caucasus, southern Syria, the Pamir-Karakorum-Himalaya mountain system, the Canary Islands, and Greenland reported in this study. To these should be added the citations of *Cercidospora epipolytropa* or one of its synonyms on *R. melanophthalma* by Vouaux (1913) and Rondon (1969) from the Western Alps in France, Lettau (1919) from Switzerland, Navarro-Rosinés & Hladun (1987) from Catalonia (Spain), Vondrák & Etayo (2007) from the Spanish Pyrenees, Lopez de Silanes et al. (1998) from northern Spain, Werner (1937, 1975) and Degelius (1966) from the Sierra Nevada (Andalucía, Spain), Werner (1934) from the Anti-Atlas in Morocco, as well as by Alstrup & Hawksworth (1990) and Alstrup et al. (2009) from Greenland. The material cited by Werner (1937) could not be found in the herbarium of this author (BC, herb. R.-G. Werner). Alstrup & Cole (1998) cite *Cercidospora ulothii* upon *Rhizoplaca melanophthalma* from the Canadian province British Columbia, as does Halıcı & Aksoy (2009) from Turkey, collections which also might belong here.

Exsiccata – None.

Additional specimens examined – (All on *Rhizoplaca melanophthalma*).

EUROPE: France: Pyrénées-Orientales, SE de Eyne, 32.VII.1985, P. Diederich (herb. Diederich 6628).– Alpes septentrionales du Dauphiné, région du col de Lautaret, dalles horizontales et \pm inclinées de schistes gréseux, versant S de la montagne de Chaillol, \pm 2300 m, VIII. 1957, G. Clauzade (MARSSJ, Lichenes Alpium 49).– Hautes Alpes, sommet de la butte, située à 300 m à l'E du col de Lautaret, 2089 m, 30.VIII.1955, G. Clauzade (MARSSJ, herb. B. de Lesdain).– Hautes Alpes, Lautaret, 10.VIII.1903, M. B. de Lesdain (MARSSJ, herb. M. Vouaux, sub *Parcidia exiguella* Nyl (ex herb. F. Camus dans l'herb. A. Boistel).– Corse, mont Renoso, gros bloc rocheux granitique dans la vallée des Pozzi, 1800 m, 18.VIII.1970, R. Deschatres (BC, herb. Werner).– **Norway:** Oppland, Lom: Jotunheimen, Visdalen, W-exponierte Hänge ca. 1 km NE von Spiterstulen, ca. 1250 m, W-exponierte Abbrüche, 24.VIII.1984, J. Hafellner 12767 & A. Ochsenhofer (herb. Hafellner).– **Spain:** Catalonia, prov. Girona, Ripollés, Queralbs, Vall de Núria, sota el Pic de l'Aliga, UTM 31TDG39, 2350 m, 1.VIII.1984, P. Navarro-Rosinés (BCN.-lich.).– Ibid., Núria N von Ribes de Freser, NE von der Bergstation der Zahnradbahn, ca. 2100-2200 m, Südhänge mit subalpinen Rasen und Kalkschieferschrofen, 27.V.1983, J. Hafellner 17653 (GZU).– Ibid., Núria N von Ribes de Freser, NW-Hänge SE über der Bergstation der Zahnradbahn, 2300 - 2400 m, Rücken und Schutt aus Kieselkalk und Kalkschiefer, 27.V.1983, J. Hafellner 17593 (herb. Hafellner).

ASIA: Afghanistan: Großer Pamir, Issiktal, ca. 4900 m s. m., auf einem Felsgrat, 3.VIII.1975, H. Huss 56 (GZU, under the name of the host).– Prov. Kabul, Tal des Pagman-Flusses, ca. 4 km oberhalb des Ortes Pagman, 34°37'N/68°55'E, alt. 2450 m, an Granitblöcken, 24.IV.1970, M. Steiner Ste 2a (GZU).– Prov. Baghlan, oberes Khinjan-Tal, bei der Brücke über den Khinjan-Fluss, 35°25'N/69°00'E, alt. 2600 m, an Silikatblöcken am Fusse eines Steppenhangs mit *Juniperus semiglobosa*, 4.VI.1970, M. Steiner Ste 40/8a (GZU).– Central Afghanistan, Deh Kundi, in summo jugo Khonak, alt. 3300 m, 1.VIII.1967, K. H. Rechinger (GZU).– **Armenia:** distr. Razdan: Caucasus, in declivibus occidentalibus montis Alibeg, in vicinitate pagi Cakhkdzor, alt. 1800–2000 m, 3.VII.1982, V. Vašák (GZU).– **Pakistan:** North Pakistan, Karakorum, on the pass Shinghai Gali, gentle ridge on the pass, 38°48'N/74°10'E, alt. 4470 m, on small boulders, 28.VII.1990, G. Miehe & S. Miehe 962a (GZU).– Karakorum, Basislager Jengutz Har (Spantik), alt. 4300 m, auf Schieferblöcken, 2.VII.1987, K. Cernic, herb. Hafellner 23221 (GZU).– NW Himalaya, Nanga Parbat-Gruppe, Diamirtal, Basislager, alt. 4600 m, Gneisfelsen, 3.VIII.1990, T. Peer (GZU).– North Pakistan, W Himalaya, Babusar Pass, 35°10'N/74°E, alt. 4300 m, relatively humid alpine Cyperaceae mats influenced by solifluction, on small boulders in scree, 20.VII.1990, G. Miehe & S. Miehe 515 (GZU, under the name of the host).– Hindukush, Tirich Valley, alt. 4200 m, on siliceous rock, 7.VIII.1993, T. Peer (GZU).– **Syria:** Südsyrien, beim Dorf Mushannaf am Ostfuß des Dschebel Arab, 1989, H. Pölzl (GZU, under the name of the host).

AFRICA: Canary Islands: Tenerife, Parque Nacional de El Teide, Roques de García, rocas volcánicas, 2125 m, 23.IX.1993, V. Calatayud (VAB-lich. 7452).– Tenerife, Las Cañadas, ca. 0,5

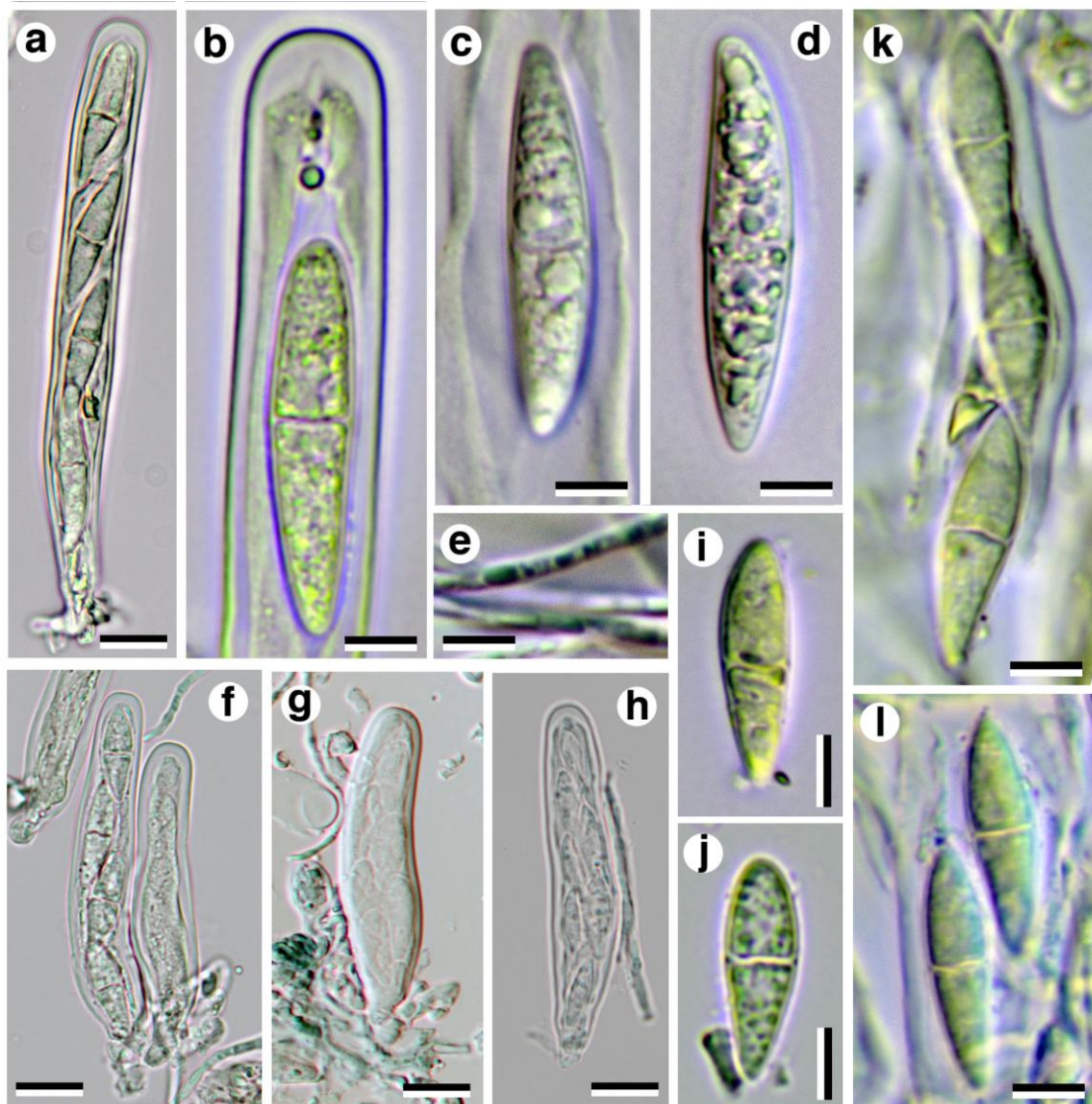


Fig. 9 – a-e *Cercidospora barrenoana* (Tenerife, Spain VAB 7436-holotype). a, ascus. b-d ascospores. e, paraphysoids. – f-l *Cercidospora melanophthalmae* (Tenerife, Spain, VAB 7452). f-h immature asci. j-l ascospores – Bars: a, f-g = 10 μ m; b-e, i-l = 5 μ m.

km W der Grenze des Nationalparks W ober El Portillo, 28°17'10''N/16°34'10''W, ca. 2100 m, Felsköpfe aus vulkanischem Gestein, 20.II.1989, J. Hafellner 41725 & A. Hafellner (GZU).– Tenerife, Las Cañadas, untere Abhänge der Guajara SE vom Parador, 28°13'00''N/16°37'25''W, ca. 2200 m, NW-exponierte schrofige Hänge mit offenem *Spartocytisus supranubius*-Gebüsch, NE-exponiert an Vulkanitschrofen, 25.IV. 2005, J. Hafellner 64181 (herb. Hafellner).– Tenerife: Las Cañadas, Montaña Guajara, auf der S-Seite knapp unter dem Gipfel, 28°13'00''N/16°36'40''W, ca. 2680 m, E-seitig an Vulkanitblöcken, 21.II.1989, J. Hafellner 32862, 36214 & A. Hafellner (GZU).– Tenerife, Las Cañadas, Sattel E unter der Guajara, 28°12'30''N/16°35'W, ca. 2250 m, Gebirgshalbwüste, auf Lavablöcken, 8.XII.1997, J. Hafellner 41060 (GZU).– Tenerife: Las Cañadas, Montaña de las Arenas Negras SE oberhalb von El Portillo [gegen Montaña Colorada], 28°17'10''N/16°33' 05''W, ca. 2250 m, N-seitig an Basaltschrofen, 20.II.1989, J. Hafellner 36166 & A. Hafellner (herb. Hafellner).– Tenerife, Cumbre Dorsal, Izaña, sanft SE-geneigte Hänge zwischen dem Observatorio Meteorológico und dem Observatorio Astronómico, 28°18'10''N/ 16°30'15''W, ca. 2350 m, kleine Vulkanitschrofen in einem *Spartocytisus supranubius*-Bestand, NE-seitig auf kleinen Vulkanitschrofen, 28.IV. 2005, J. Hafellner 64331 (GZU).

NORTH AMERICA: Greenland: W-Grönland, Disko, Lyngmark, untere Hänge des Lyngmarkjeld N Godhavn, Basalt 50-320 m, VII. 1983, J. Poelt & H. Ullrich (GZU).– Disko, Umgebung von Godhavn, Gneisgebiet NE des Fjordes Kangerdlwarssuk, NE des Ortes Diskofjord, um 50 m, 4.VIII.1982, J. Poelt & H. Ullrich (GZU).

Cercidospora stenotropae Nav.-Ros. & Hafellner, **ad int.**

Fig. 4, 7 a-j.

Description – Ascomata perithecioid, (95–)110–150 μm diam., globose. Exciple colorless in its lower part, green-blue or with some brown tinges around the ostiole, 10–15 μm thick towards its base. Paraphysoids abundant, 1–1.5 μm thick. Asci 40–55(–65) \times 8–10(–12) μm , cylindrical-clavate, with (2–)4 ascospores. Ascospores (13–)15–18.3–21(–22) \times (4.5–)5–5.3–6 μm , with a length/width ratio of (2.6–)3.0–3.5–4.0(–4.3) ($n = 75$), 1-septate, \pm narrowly ellipsoid to slightly fusiform, both cells with a similar size, septum median, but slightly heteropolar, the lower cell slightly narrower than the upper one. Pycnidia globose, 50–70 μm diam. Pycnidiospores colorless, simple, bacilliform, 3–5 \times 0.5–1 μm .

Remarks – *Cercidospora stenotropae* has the smallest ascomata and asci of all taxa herein treated. The asci are mostly 4-spored, but some 2-spored ones were also occasionally observed. Ascospore size is smaller than all 4-spored taxa and more closely resembles that found in *C. melanophthalmae* and *C. epipolytropae*, two species with mostly 8-spored asci. In size and ellipsoid-fusiform shape, *C. stenotropae* ascospores are almost identical to those of *C. melanophthalmae*. In *C. epipolytropae* they are slightly smaller and predominantly oval-ellipsoid (see also comments under these taxa).

Distribution and habitat – *C. stenotropae* is so far known with certainty from the localities here reported. This taxon grows in the apothecia of *Lecanora stenotropa* and other species of the *L. polytropae* group with scarcely developed thallus, in many cases reduced to only the margin of the apothecia. These lichen specimens always come from localities at lower altitudes (400–1600 m) than those where samples infected by *C. epipolytropae* were collected. It is quite probable that some reports of *C. stenotropae* have been included in a wide sense of *C. epipolytropae*.

A *Cercidospora* specimen from Antarctica growing on *Rhizoplaca aspidophora*, which was also examined, has similarly sized asci and ascospores with the same number of ascospores per ascus. Given the different host species, however, we prefer to list it separately under *C. cf. stenotropae*, until more material on this host is available for study.

Exsiccata – None.

Specimens examined – **EUROPE: Austria:** Steiermark, Cetiche Alpen, Wechsel, Lesestein-Haufen am Wiesenhang oberhalb des Spitzbauer, um 1000 m (an der Bergstraße von Mönichwald zum Wechsel), SE-exponiert, 8.IX.1989, J. Poelt (GZU). On *L. polytropae* group.– Fischbacher Alpen, Steiermark, Unterste N- bis W-seitige Abbrüche des Buchberges (N Schloß Herberstein) gegen den Stubenbergsee bzw. die Feistritz, 400-420 m, 6.XI.1988, J. Poelt (GZU). On *L. polytropae* group.– **Belgium** (distr. ardennais): Prov. Luxembourg, Arville, Sart-aux-Pîres, right side of the river Lomme IFBL: J6.56, 310 m, on schistose rocks containing heavy metals on SW-exposed railway cutting, 4.V.1997, P. Diederich 12585 (herb. P. Diederich). On *Lecanora gisleriana* Müll. Arg.– **Germany:** Harz, Bez. Halle, Wald, Wegräder am Aufstieg von Drei-Annen-Hohne zu den Hohneklippen W Elbingerode, 800-900 m, 8.IX.1979, J. Poelt (GZU). On *L. polytropae* group.– Sachsen-Anhalt, Eisleben-Kreisfeld, auf Kupferschiefer der Halde N vom Sportplatz Kreisfeld, 9.II.1994, leg. S. Huneck (herb. P. Diederich). On *L. stenotropa*.– **Italy:** Toscana, prov. Arezzo, Pratomagno W Bibbiena, Aufstieg von Raggiolo zum Kamm zwischen Croce di Pratomagno und Pgio. Masserecci, 1000 m, VII.1980, C. Scheuer (GZU). On *L. polytropae* group.– **Spain:** Castilla y León, prov. Soria, Molinos de Razón, Sierra Cebollera, alrededores de la laguna. sobre roca silicea, ca. 2000 m, 1.XI.1996, V. Calatayud & C. Trescolí (VAB-lich. 7726). On *L. polytropae* group.– Catalonia, prov. Girona, Baixa Cerdanya, Gréixer, cerca del pueblo U.T.M. 31TDG0396, 1400 m, 30.XI.1990, X. Llimona & J.M. Pérez-Redondo (BCN-lich.). On *L. stenotropa*.– Catalonia, prov.

Girona, Baixa Cerdanya, Meranges, prado cerca de Girult, U.T.M. 31TCH9900, 1600 m, 17.IV.1992, X. Llimona & J.M. Pérez-Redondo (BCN-lich.). On *L. stenotropa*.

NORTH AMERICA: U.S.A., Arizona: Apache Co., Mt. Baldy Wilderness, Baldy Peak, at the summit, ca. 3400 m, 33°54'30''N/109°34'W; basaltic rock, on small outcrops exposed to SW, 4.VII.1994, J. Hafellner 36684 (GZU, under the name of the host). On *L. polytropae*.

Specimen examined of *Cercidospora* cf. *stenotropae* (on *Rhizoplaca aspidophora*).—**ANTARCTICA**: Byero “El Petrel”, cima rocosa, c. 15 m, 31.I.1990, L.G. Sancho (herb. J. Etayo 15117).

Cercidospora sp. 1

Remarks – This taxon, which was recently cited in the checklist of Virginia lichens, has not been available for study so far.

Distribution and habitat – This unknown *Cercidospora* has been recorded so far only from Virginia, U.S.A., where it was detected upon *Rhizoplaca subdiscrepans* (Hodkinson et al. 2009).

Acknowledgements

The authors are indebted to Dr. P. Diederich (Luxembourg) and Dr. C. Roux (Marseille) for their valuable comments on the manuscript. We thank the curators of the herbaria cited in the text for sending us material in their care for examination. P.N.-R.'s work was carried out within the projects: CGL 2007-66734-C03-02/BOS (Ministerio de Educación y Ciencia, Gobierno de España), 2005 SGR01047, GR-Criptogàmia (Departament d'Universitats, Recerca i Societat de la Informació, Generalitat de Catalunya). V.C. thanks Generalitat Valenciana, and the Programm CONSOLIDER-INGENIO 2010 (GRACCIE) for supporting to Fundación CEAM.

References

- Alstrup V, Cole MS. 1998 – Lichenicolous fungi of British Columbia. *Bryologist* 101, 221–229.
- Alstrup V, Hawksworth DL. 1990 – The lichenicolous fungi of Greenland. *Meddel. Grønland. Biosci.* 31, 1–90.
- Alstrup V, Kocourková J, Kukwa M, Motiejūnaitė J, Brackel W, Suija A. 2009 – The lichens and lichenicolous fungi of South Greenland. *Folia Cryptog. Estonica* 46, 1–24.
- Candal M, Halıcı MG. 2011 – New *Cercidospora* records for Turkey. *Turk. J. Bot.* 35, 625–629.
- Clauzade G, Roux C. 1985 – Likenoj de Okcidenta Eŭropo. *Ilustrita determin-libro. Bull. Soc. Bot. Centre-Ouest, nouv. sér., Num. spéc.* 7, 893 pp. Royan.
- Degelius G. 1966 – Lichens of the summit of the Picacho de Veleta (Sierra Nevada, Spain). A contribution to the knowledge of the flora at high altitudes. *Svensk Bot. Tidskr.* 60(2), 338–340.
- Grube M, Hafellner J. 1990 – Studien an flechtenbewohnenden Pilzen der Sammelgattung *Didymella* (Ascomycetes, *Dothideales*). *Nova Hedwigia* 51(3–4), 283–360.
- Grube M, Baloch E, Arup U. 2004 – A phylogenetic study of *Lecanora rupicola* group (*Lecanoraceae*, *Ascomycota*). *Mycol. Res.* 108(5), 506–514.
- Hafellner J. 1987 – Studien über lichenicole Pilzen und Flechten VI. Ein verändertes Gattungskonzept für *Cercidospora*. *Herzogia* 7, 355–365.
- Hafellner J, Casares-Porcel M. 2003 – Lichenicolous fungi invading lichens on gypsum soils in southern Spain. *Herzogia* 16, 123–133.
- Halıcı MG, Aksoy A. 2009 – Lichenised and lichenicolous fungi of Aladağlar National Park (Niğde, Kayseri and Adana Provinces) in Turkey. *Turkish J. Bot.* 33, 169–189.
- Hawksworth DL, Diederich P. 1988 – A synopsis of the genus *Polycoccum* (*Dothideales*), with a key to accepted species. *Trans. Brit. Mycol. Soc.* 90(2), 293–312.
- Hodkinson BP, Harris RC, Case MA. 2009 – A checklist of Virginia lichens. *Evansia* 26(2), 64–88.

- Laundon JR. 2010 – *Lecanora antiqua*, a new saxicolous species from Great Britain, and the nomenclature and authorship of *L. albescens*, *L. conferta* and *L. muralis*. - Lichenologist 42(6), 631–636.
- Lettau G. 1919 – Schweizer Flechten. II. Hedwigia 60(4), 267–312.
- Lopez de Silanes ME, Terrón A, Etayo J. 1998 – Líquenes y hongos liquenícolas de Fuentes Carrionas, Sierra de Riaño y Valle de Liébana (N de España). Nova Acta Ci. Compostelana (Biol.) 8, 47–89.
- Mudd W. 1861 – A manual of British lichens, containing description of all the species and varieties and five plates, with figures of the spores of one hundred and thirty species, illustrative of the genera. Darlington, For the author by Harrison Penney. 309 pp.
- Miadlikowska J, Kauff F, Hofstetter V, Fraker E, Grube M, Hafellner J, Reeb V, Hodgkinson BP, Kukwa M, Lücking R, Hestmark G, Garcia Ojalora M, Rauhut A, Büdel B, Scheidegger C, Timdal E, Stenroos S, Brodo I, Perlmutter G, Ertz D, Diederich P, Lendemer JC, May P, Schoch CL, Arnold AE, Gueidan C, Tripp E, Yahr R, Robertson C, Lutzoni F. 2006 – New insights into classification and evolution of the Lecanoromycetes (Pezizomycotina, Ascomycota) from phylogenetic analyses of three ribosomal RNA- and two protein-coding genes. Mycologia 98, 1088–1103.
- Navarro-Rosinés P, Hladun NL. 1987 – Aportación a los hongos liquenícolas, liquenizados o no, en Catalunya. Act. VI Simposio Nat. Bot. Cript., 431–440. Granada.
- Navarro-Rosinés P, Roux C, Casares M. 1995 – Hongos liquenícolas de *Squamarina*, II, Sobre la identidad de "*Didymella*" *crozalsiana* (Ascomycetes). Cryptog., Bryol. Lichénol. 16(2), 99–103.
- Navarro-Rosinés P, Calatayud V, Hafellner J. 2004 – *Cercidospora*. pp. 635–639 in: Nash TH III, Ryan BD, Diederich P, Gries C, Bungartz F (eds.): Lichen Flora of the Greater Sonoran Desert Region, Volume 2. Lichens Unlimited, Arizona State University, Tempe, Arizona.
- Navarro-Rosinés P, Calatayud V, Hafellner J. 2009 – Contributions to a revision of the genus *Cercidospora* (*Dothideales*) 1. Species on *Megasporaceae*. Mycotaxon 110, 5–25.
- Obermayer W, Kantvilas G. 2003 – The identity of the lichens *Siphula himalayensis* and *Lecanora teretiuscula*. Herzogia 16, 27–34.
- Pérez-Ortega S, Spribille T, Palice Z, Elix JA, Printzen C. 2010 – A molecular phylogeny of the *Lecanora varia* group, including a new species from western North America. Mycol. Progress 9, 523–535.
- Poelt J, Grube M. 1993 – Beiträge zur Kenntnis der Flechtenflora des Himalaya VIII. – *Lecanora* subgen. *Placodium*. Nova Hedwigia 57, 305–352.
- Purvis OW, Coppins BJ, Hawksworth DL, James PW, Moore DM. 1992 – The lichen flora of Great Britain and Ireland. London: Natural History Museum Publications and the British lichen Society. 710 pp.
- Rondon Y. 1969 – L'herbier des champignons parasites des lichens de l'abbé L. Vouaux. Rev. Bryol. Lichénol. 36, 737–745.
- Santesson R. 1960 – Lichenicolous fungi from northern Spain. Svensk Bot. Tidskr. 54, 499–522.
- Santesson R. 1993 – The lichens and lichenicolous fungi of Sweden and Norway. Lund: SBT-förlaget. 240 pp.
- Santesson, R. 1998 – Fungi lichenicoli exsiccati. Fasc. 11 & 12 (Nos 251–300). Thunbergia 28, 1–19.
- Triebel D, Rambold G, Nash III TH. 1991 – On lichenicolous fungi from continental North America. Mycotaxon 42, 263–296.
- Vainio EA. 1921 – Lichenografia fennica I. Pyrenolichenes iisque proximi Pyrenomycetes et Lichenes imperfecti. Acta Soc. Fauna Fl. Fenn. 49(2), 1–274.
- Vondrák J, Etayo J. 2007 – A contribution to the diversity of lichen-forming and lichenicolous fungi in the Spanish Pyrenees. Herzogia 20, 189–198.
- Vouaux L. 1912–1914 – Synopsis des champignons parasites de liquens. Bull. Soc. Mycol. France 28(1912), 177–256; 29(1913), 33–128, 395–494; 30(1914), 135–198, 281–329.

- Werner R-G. 1934 – Étude sur la végétation cryptogamique du massif du Siroua (Anti-Atlas). Bull. Soc. Sci. Nat. Maroc 14, 214–235.
- Werner R-G. 1937 – Recherches phytogéographiques comparées sur la flore cryptogamique de l'Espagne méridionale et du Maroc. Bull. Soc. Sci. Nat. Maroc 17, 32–66.
- Werner R-G. 1975 – Étude écologique et phytogéographique sur les lichens de l'Espagne méridionale. Rev. Bryol. Lichénol. 41, 55–82.
- Wirth V. 1995 – Flechtenflora. 2. Auflage. Stuttgart, E. Ulmer. 661 pp.
- Zhurbenko MP. 2007 – The lichenicolous fungi of Russia, geographical overview and a first checklist. Mycologia Balcanica 4(3), 105–124.