

Cercidospora alpina sp. nov. and a key to the known species in Fennoscandia

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Abstract: The new fungus *Cercidospora alpina* is described from Sweden where it grows on the thallus of the crustose lichen *Stereocaulon cumulatum*. The ecology and distribution of the new species as well as its morphological similarities to related species are discussed. A key to the known species of *Cercidospora* occurring in Fennoscandia is provided.

Key words: distribution, lichenicolous, *Stereocaulon cumulatum*, Sweden

Introduction

While carrying out fieldwork in 2003 and 2004, in connection with our study of the Swedish lichenicolous fungi (e.g., Ihlen 2004; Ihlen *et al.* 2004; Ihlen & Wedin 2004, 2005), we became aware of a species of *Cercidospora* Körb. growing on the crustose lichen *Stereocaulon cumulatum* (Sommerf.) Timdal. This lichen is common in the mountains of Scandinavia and can be found along footpaths and on wind eroded sites, where it grows on soil, sand, gravel, and more rarely in crevices of rock in open situations (Timdal 2002). The *Cercidospora* found on this lichen is characterized mainly by relatively large perithecioid ascomata (200–350 µm in diameter) with a green peridium, 8-spored asci with a short ocular chamber, and 3–4-septate ascospores (19.5–33 × 4–7 µm). This combination of characters does not agree with those of any described *Cercidospora* species (Hafellner 1987; Triebel 1989; Hafellner & Obermayer 1995; Zhurbenko 2002), or to our knowl-

edge, in any other paper dealing with *Cercidospora* (e.g., Grube & Hafellner 1990; Hafellner 1993; Alstrup *et al.* 1994; Ihlen 1995, 1998; Alstrup 1997). Consequently, it is described below as new species.

The discovery of a further species of *Cercidospora*, on a new host lichen, prompted us to also include a key to the species occurring in Fennoscandia, i.e., Norway, Sweden and Finland (see Santesson *et al.* 2004).

Material and Methods

In addition to the specimens of *Cercidospora alpina* collected in the field, two specimens were found by examining herbarium specimens of *Stereocaulon cumulatum* in BG and UPS. For anatomical studies, a Zeiss light microscope with magnifications of × 400, × 630, and × 1000, equipped with a blue filter, was used. The estimated values of the sizes of the ascospores have been given as:

(min.–) arithmetic mean – 1.0 SD – arithmetic mean + 1.0 SD (–max.)

where min. and max. are the extreme values and SD the corresponding standard deviation of the sample. All measurements were made on material mounted in water, except for the sizes of the ascospores that were measured in K (i.e., a 10% solution of potassium hydroxide). The measurements were made on mature ascospores only and in K in order to observe details in these structures more clearly, for example septation.

Materials used for comparison. *Cercidospora decolorata*. **Norway:** Nord-Trøndelag: Grong, Geitfjellet, 1993, O. E. Eriksson (UMU).

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Cercidospora punctillata (syn. *C. lichenicola*). **Sweden:** Härjedalen, Tännäs, c. 6 km SE of Mt. Skarsen, c. 2.5 km NNW of Klinken, 1988, R. Santesson 32472 (UPS).

***Cercidospora alpina* Ihlen & Wedin sp. nov.**

Fungus lichenicola in thallis lichenis *Stereocauli cumulati* immersus. Ascumata perithecioida, globosa, 200–350 µm in diametro, semiimmersa, peridiis viridibus. Asci 8-sporei. Ascosporeae (18.0–)19.5–33.0(–43.0) × (4.0–)4.5–6.5(–7.0) µm, 3–4 (–7) septatae.

Typus: Sweden, Jämtland, Bergs kommun, on the summit of Mt. Falkfångarfället, 63°02'32.3"N, 13°46'38.4"E, alt. 1180 m. In the lower alpine zone. On *Stereocaulon cumulatum* on soil, 5 September 2004, Per G. Ihlen 1498 (UPS—holotypus).

Ascumata perithecioid, half immersed, black, globose, 200–350 µm diam. when mature; ostiole present, but soon indistinct in surface view as the upper part of the ascumata frequently becomes wrinkled when mature; *peridium* in upper part green, 25–40 µm thick, in lower part light green to hyaline and then indistinctly delimited from the host, 10–25 µm thick; pigment K–, N+ dull purple. *Hamathelial filaments* branched and anastomosed, 1.0–2.0 µm thick, not swollen at apices. *Asci* bitunicate, cylindrical to elongate-clavate, 60–75 × 14–18 µm, with a short and indistinct ocular chamber; asci K/I–, 8-spored. *Ascospores* narrowly ellipsoid, frequently with slightly pointed end cells, hyaline, (18.0–)19.5–33.0(–43.0) × (4.0–)4.5–6.5(–7.0) µm (*n*=19), 3–4(–7) septate; perispore present.

Conidiomata and vegetative hyphae not observed.

Ecology and distribution. *Cercidospora alpina* has been found exclusively on *Stereocaulon cumulatum* growing on soil in the lower alpine zone. Associated lichen taxa, recorded on the same piece of substratum, included *Cladonia coccifera* (L.) Willd., *Lecidoma demissum* (Rutstr.) Gotth. Schneid. & Hertel, *Ochrolechia frigida* (Sw.) Lynge, and *Solorina crocea* (L.) Ach. The species has so far been recorded from the provinces Jämtland (type) and Lule Lappmark. The

altitude of the localities ranged from 500 m in Lule Lappmark to 1180 m in Jämtland.

Additional specimens examined. **Sweden:** Lule Lappmark: Jokkmokk, the northern slope of Mt. Jarre, south of lake Karats, c. 50 km W of Jokkmokk, 66°38'N, 18°45'E, 2003, Ihlen 1352 (UPS); Mt. Sjnjerák, c. 4 km E of Kvikkjokk, 66°57'N, 17°48'E, 2003, Ihlen 1371 (UPS); Gällivare, Soldalen, just NW of place Vietas, between the lakes Langas and Suorvajaure, 67°29'48"N, 18°19'55"E, 2004, Ihlen 1487 (UPS).

Specimens examined labelled Stereocaulon cumulatum. **Sweden:** Jämtland: Åre, Mörvikshummeln, Gösta Kjellmert (UPS); 1.5 km SSW of point 707 of Täljstensberget, 1967, Tibell 3122 (UPS).

Discussion

There are two groups within *Cercidospora* with ascospores containing more than one septum that might resemble *C. alpina*. The first group includes *C. cladoniicola* Alstrup, *C. lecidomae* Zhurb. & Triebel, *C. soror* Obermayer & Triebel, *C. stereocaulorum* (Arnold) Hafellner, and *C. thammoliicola* Ihlen. All these species can easily be separated from *C. alpina* by having up to 3-septate ascospores and, in addition, *C. soror* and *C. stereocaulorum* have 4-spored asci (Hafellner & Obermayer 1995; Ihlen 1995; Alstrup 1997; Zhurbenko & Triebel 2003). Further differences can be found in the literature references in the key given below.

However, the second group, containing *C. decolorella* (Nyl.) O. E. Erikss. & J. Z. Yue (see Zhurbenko & Hafellner 1999; Zhurbenko & Triebel 2003) and *C. punctillata* (Nyl.) R. Sant. (see Zopf 1897, as *Leptosphaeria lichenicola* Zopf and Hafellner 1987, as *C. lichenicola*) is morphologically most similar to *C. alpina*. *Cercidospora alpina* can be separated from both these species by its much larger ascumata that are, because of the wrinkling in the upper part of ascumata when mature, frequently without a distinct ostiole in surface view. In *C. decolorella* and *C. punctillata*, the ascumata are 150–200 µm in diameter and a distinct ostiole is always present in surface view (very distinct when wet). Furthermore, the ascospores of *C. alpina* are longer than those of *C. punctillata*; here they are 18–23 µm in length (Hafellner 1987). In *C. decolorella*, the estimates of the

ascospore length differ between authors: in Zhurbenko & Hafellner (1999) and Zhurbenko & Triebel (2003) the length was estimated to be 17–25 µm, whereas in Vainio (1921, as *Metasphaeria decolorella* (Nyl.) Vain.) the length was estimated to be 20–32 µm. In the specimen of *C. decolorella* used for comparison, the ascospore length agreed with that of Vainio (1921). The septation of the ascospores also seems to differ between these three species. When mature, *C. alpina* has predominantly 3- or 4-septate ascospores, *C. decolorella* has predominantly 5-septate ascospores (see also Vainio 1921), whereas *C. punctillata* has mainly 3-septate ascospores (although four or five septa may occur). In the same specimen of *C. decolorella* used for comparison, an ascospore with up to eight septa was also found and such a high number of septa has, as far as we know, not been recorded in *C. punctillata* (in *C. alpina* one outlying ascospore with seven septa was recorded).

In addition, *C. alpina* can be separated from *C. punctillata* by its small and frequently indistinct ocular chamber; in *C. punctillata* it is usually distinct in water. Another character that separates *C. alpina* from *C. decolorella* is that the latter has a light brown pigment in the lower part of the peridium and a green pigment in the upper part, whereas *C. alpina* contains the green pigment only.

Finally, *C. alpina* is lichenicolous on *Stereocaulon cumulatum* whereas *C. decolorella* and *C. punctillata* are terricolous on algal films and bryophytes (possibly also lichens) and, in Scandinavia, lichenicolous on *Peltigera leucophlebia* and *Solorina crocea*, respectively (Santesson *et al.* 2004). In Russia, *C. punctillata* has also been found on *Micarea incrassata*, *Mycobilimbia hypnorum*, *Pannaria pezizoides*, *Peltigera malacea*, *Phaeorrhiza nimbosea*, *Psoroma hypnorum*, and *Sphaerophorus globosus* (Zhurbenko 2002).

As pointed out, *C. alpina*, *C. decolorella*, and *C. punctillata*, are morphologically quite similar. However, despite the fact that we are quite confident with the characters used here to separate them, we believe that the taxonomic ranks of members of this complex, i.e. whether they represent distinct species or infraspecific taxa, can be clarified only by phylogenetic analyses based on molecular data.

Heavily infected parts of *Stereocaulon cumulatum* containing *C. alpina* soon become grey and later partly or completely eroded, which suggests that it is a parasite. *Cercidospora alpina* has so far been recorded from relatively few localities and, because the host is common in the mountains of Scandinavia (Timdal 2002), it is obviously under-collected. We therefore believe that its distribution is much wider than that given here.

Key to the species of *Cercidospora* in Fennoscandia

For a summary of the occurrences in provinces of the species, see Santesson *et al.* (2004). It should be noted that Santesson *et al.* (2004: 81) lists *Cercidospora galligena* Hafellner from a thallus of *Aspicilia* sp., but as this is a *nomen nudum*, and accordingly not validly published, it has not been included in the key. It should also be noted that we have accepted the placement of *Cercidospora cephalodiorum* Triebel & Grube in *Collemopsidium* Nyl. (Grube 2005). The names of species in the key are followed by selected references to literature on their morphology, distribution and ecology.

- | | | |
|-------|--|----|
| 1 | Ascospores 1-septate | 2 |
| | At least some ascospores with more than one septum | 11 |
| 2 (1) | Fungus growing directly on thallus and/or apothecia of the host lichen | 3 |
| | Fungus growing on the cephalodia of <i>Pilophorus dovreensis</i> | |
| | Collemopsidium cephalodiorum Grube, | |

- see Triebel (1989, as *Cercidospora cephalodiorum* Triebel & Grube) and Grube (2005)
- 3 (2) On thalli and/or apothecia of *Lecanora* or *Protoparmeliopsis muralis* 4
On thalli and/or apothecia of other lichens 5
- 4 (3) Asci usually 8-spored; ascospores 14–18 µm in length; on thalli and apothecia of *Lecanora dispersa*, *L. intricata* and *L. polytropa*
. ***Cercidospora epipolytropa*** (Mudd) Arnold,
see Hafellner (1987)
Asci usually 4-spored; ascospores 18–24 µm in length; on thallus and apothecia of *Protoparmeliopsis muralis*
. ***Cercidospora macrospora*** (Uloth) Hafellner & Nav.-Ros.,
see Hafellner (1987, as *C. ulothii*)
- 5 (3) On thallus of *Xanthoria elegans*
. ***Cercidospora epicarphinea*** (Nyl.) Grube & Hafellner 1990
Not on thallus of *Xanthoria elegans* 6
- 6 (5) Fungus causing at least some small gall-formations on the host thallus and/or on the rhizocarpic acid-producing genera *Arthrorhaphis* or *Rhizocarpon* 7
Fungus not causing small gall-formation on the host thallus. On lichen genera not producing rhizocarpic acid 8
- 7 (6) Fungus forming galls on the host thallus; peridium in section brown to green in upper part; ascospores 5–8 µm broad; on thallus of *Rhizocarpon geographicum* s. lat. ***Cercidospora cecidiiformans*** Grube & Hafellner,
see Hafellner (1993) and Ihlen & Wedin (2005)
Fungus not gall-forming; peridium in section greenish black in upper part; ascospores 4–6 µm broad; on thallus of *Arthrorhaphis alpina*
. ***Cercidospora trypetheliza*** (Nyl.) Hafellner & Obermayer 1995
- 8 (6) Upper part of the peridium in section green 9
Upper part of the peridium in section brown to dark brown; on thallus of *Rinodina mmiaraea* ***Cercidospora exiguella*** (Nyl.) Arnold,
see Magnusson (1952, as *Didymella epipolytropa* var. *ulothii*).
- 9 (8) Ascospores >16–17 µm in length 10
Ascospores <16–17 µm in length; on thalli of *Baeomyces placophyllus* and *B. rufus* ***Cercidospora parva*** Hafellner & Ihlen,
see Ihlen (1998)
- 10 (9) Ascospores 17–30 × 5–7 µm; on thallus and apothecia of *Squamarina lentigera* ***Cercidospora crozalsiana*** (H. Olivier) Nav.-Ros., Cl. Roux & Caseres,
see Navarro-Rosinés *et al.* (1995)
Ascospores 16–19 × 5–6 µm; on thallus of *Megaspora verrucosa*
. ***Cercidospora verrucosaria*** (Linds.) Arnold,
see Vouaux (1913)
- 11 (1) Ascospores up to 3-septate 12
Mature ascospores with 3 or more septa 16

- 12 (11) Peridium in section brown, hamathecial filaments sparse, ascospores 11–16 µm in length, and lichenicolous on *Thamnolia vermicularis* **Cercidospora thamnoliicola** Ihlen 1995
Fungus different 13
- 13 (12) Asci 8-spored 14
Asci 4-spored (the asci might be 8-spored at first, but only four reach maturity) 15
- 14 (13) Ascospores 1–3-septate; on thallus of *Lecidoma demissum* **Cercidospora lecidomae** Zhurb. & Triebel, see Zhurbenko & Triebel (2003)
Ascospores 3-septate; on thallus of *Cladonia arbuscula* **Cercidospora cladoniicola** Alstrup 1993
- 15 (13) On thallus of *Arthrorhaphis citrinella* **Cercidospora soror** Obermayer & Triebel, see Hafellner & Obermayer (1995) and Ihlen (1997)
On *Stereocaulon alpinum* and *S. vesuvianum* **Cercidospora stereocaulorum** (Arnold) Hafellner, see Hafellner (1987) and Hawksworth (1982, as *Metasphaeria stereocaulorum*)
- 16 (11) Peridium in section often light brown in lower and middle part; ascospores predominantly 5-septate (sometimes up to eight septa); on terricolous algal films and bryophytes, possibly also lichens **Cercidospora decolorella** (Nyl.) O. E. Erikss. & J. Z. Yue, see Vainio (1921, as *Metasphaeria decolorella* (Nyl.) Vain.), Zhurbenko & Hafellner (1999), and Zhurbenko & Triebel (2003).
Peridium in section green, never light brown; ascospores predominantly 3-septate or 3 to 4-septate; never on terricolous algal films and bryophytes 17
- 17 (16) Ascomata 150–200 µm in diameter; asci with a distinct ocular chamber; ascospores 18–23 µm long, predominantly 3-septate (although four or five may occur); on thalli and apothecia of *Peltigera leucophlebia* and *Solorina crocea* **Cercidospora punctillata** (Nyl.) R. Sant., see Zopf (1897) and Hafellner (1987), both as *C. lichenicola*
Ascomata 200–350 µm in diameter; asci with an indistinct and/or short ocular chamber; ascospores (18–)19.5–33(–43) µm long, predominantly 3–4-septate; on thallus of *Stereocaulon cumulatum* . **Cercidospora alpina** Ihlen & Wedin

Addendum

We find it appropriate to include the discovery of another fungus that is almost always present on the thallus of *Stereocaulon cumulatum* (also found on *Lecidoma demissum*). This fungus is mainly characterized by forming some brown and globose structures, 30–50 µm in diameter. Despite many attempts, we have not found any asci, spores or conidia within these structures, only some green and simple cells, 8–12 × 4–10 µm that

most probably are not related to the fungus. *Intralichen* cf. *lichenicola* (M. S. Christ. & D. Hawksw.) D. Hawksw. & M. S. Cole (see Hawksworth 1979: 264, as *Trimmatostroma lichenicola*) is also almost always found on the host thallus as well as in between this unknown fungus. Consequently, we would like to make lichenologists and mycologists aware of this fungus and encourage them to search for asci, ascospores or conidia of

this very common and most probably undescribed fungus.

Specimens seen (in addition to those listed under *Cercidospora alpina*). On *Stereocaulon cumulatum*: Ihlen 1128, 1296, 1351, 1394, 1405, and 1467 (all UPS). On *Lecidoma demissum*: Ihlen 1286 and 1350 (all UPS).

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