
Four Species from New Mexico and Europe (Acarosporaceae)

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Abstract: The lichenicolous fungus *Sarcogyne bicolor* H. Magn. was recovered as an *Acarospora* and is given the replacement name, *Acarospora destructans*. It is reported new from New Mexico. Two new species of *Acarospora* are described from New Mexico, *Acarospora eganiana* and *A. worthingtoniana*. A form or variety of *A. glaucocarpa* is treated as a species, *Sarcogyne melaniza*, an apparently rare taxa in Europe.

Keywords: Chihuahuan Desert, pathogenic lichenicolous fungi, species based on a single specimen.

Introduction

The lichenicolous fungus *Acarospora destructans* is published here as a replacement name for *Sarcogyne bicolor* H. Magn. and to correct the misapplication of names of European species to a North American species (Knudsen 2005, 2007; Knudsen & Kocourková 2009).

We publish two new species of *Acarospora* from New Mexico from single specimens. We supply pictures, sequences, and a description for identification. They are published to establish a nomenclatural type so this data will not be lost and hopefully other populations will be found. *Acarospora worthingtoniana* was definitely rare in our study area. See the discussion. *Acarospora eganiana* was discovered in GZU herbarium and that is the only known collection. We know from studying many descriptions and types of lichens from the past based on one specimen or from dealing with descriptions of lichenicolous fungi based on one specimen that their naming preserved data which led to the discovery of new populations.

Sarcogyne melaniza is a new combination recognizing a variety of the European *Acarospora glaucocarpa* group as a species (Knudsen et al. 2020; Westberg et al. 2015). While well known as a splitter, A. H. Magnusson was also at times a lumpner as he was with his concept of *A. glaucocarpa* (Knudsen et al. 2020).

Methods

For methods of analysis, imaging, and DNA extraction, amplification, and sequencing see Knudsen et al. (2021a).

Taxonomy

Acarospora destructans K.Knudsen, Kocourk. & Hodková, nom. nova Fig. 1
MB842864

Type: U.S.A. California: Los Angeles Co., Santa Monica Mountains “With *Acarospora fuscata*”, on ocean bluffs at Point Dume, August 1898; *H. E. Hasse s.n.* (FH, holotype!).

=*Sarcogyne bicolor* H. Magn., Annals Cryptog. Exot. 7: 130 (1935)
non *Acarospora bicolor* (Vain.) Zahlbr. [MB 375492]

Etymology. Name refers to it being a pathogenic lichenicolous fungus, destroying its host.

Description. Lichenicolous, thallus endokapylic or endolithic, vegetative hyphae usually 0.5 mm wide, hyaline, often found growing in rock and adjoining host, sometimes in crevices of rock on the white clumps of the necrotic fungal tissue of hosts still containing a few remaining algal cells. Lecideine apothecia 0.3–0.6(–3) mm, 200–500 µm thick, excluding melanized epihymenial accretions which form several melanized mounds usually 30–40 µm high with black or red-brown apothecial surface between them, margin segmented in irregular shaped units, up to 100 µm thick, outer layer melanized and hyphae not visible, up to 80 µm thick, inner layer reddish brown to hyaline, hyphae 0.5–1.0 µm, branching. Large apothecia 1–3 mm wide are compound and in the process of replicating by decision. Hymenium (60–)90–120 µm high, epihymenium 20–30 µm high, reddish brown to black, paraphyses 1–2 µm wide, variable, with or without branching, hymenial gel blue to red or red in IKI, hemiamyloid. Asci 50–75 × 12–22 µm, ascospores (3–)4.5(–5) × (1.0–)1.5–2.5 µm. Subhymenium 20 µm thick, IKI+ dark blue. Hypothecium 40–80 µm thick, in living host thallus forming a thick cloudy structure in which sometimes are visible algae, in dead host tissue the hypothecium semi-obscure sometimes becoming reddish-brown and vegetative hyphae visible. Pycnidia not observed. Not producing any secondary metabolites. Sequences generated for this study: nrITS (OM522312), nrLSU (OM572525) (*Knudsen 12813*, SBBG); nrITS (OM522311), mtSSU (OM522315) (*Kocourková 10557*, hb. K&K). Both specimens are from Joshua Tree National Park in the Mojave Desert in southern California on unknown hosts. The figure is of *A. destructans* growing on an unknown host in Fremont Canyon in the Santa Ana Mountains in southern California.

Ecology and distribution. Endolithic, parasitic on endolithic thalli, and endokapylic in a variety of saxicolous lichens, especially *Acarospora*, *Aspicilia*, *Caloplaca* and *Lecidea* species, on usually acid rock but occasionally on calcareous rock especially where it interfaces with acid rock. Widespread in North America (CNALH 2022) see under the names *Polysporina lapponica* and under *Acarospora subfuscescens*, but not to be confused with European specimens with these names; and see North American collections examined as *P. subfuscescens* in Knudsen & Kocourková (2009) (available for free download on Research Gate).



Fig. 1. *Acarospora destructans*, apothecia of the fungus on an unknown host.

In southern California, where the type of *A. destructans* was collected, it is frequent along the Pacific Coast (Baja California north to at least San Luis Obispo Co.), on the Channel Islands (Santa Cruz, Santa Rosa) and in coastal ranges (the Santa Ana and Santa Monica Mountains). On the edge of the coastal plain in southern California, *A. destructans* occurs in the Peninsular and Transverse ranges (San Jacinto, San Bernardino Mountains, and Little San Bernardino Mountains) and thrives in the Sonoran Desert (Anza Borrego) and in the Mojave Desert (Joshua Tree National Park). Its highest recorded elevation is 2473 m on the Devil's Slide in the San Jacinto Mountains parasitic on two endolithic lichens, an undescribed *Sarcogyne* species and *Lecidea hassei* (Knudsen 7217, SBBG). It is rare in the Sonoran Desert in Arizona (Knudsen 2007). It is reported new for New Mexico growing in the Chihuahuan Desert on *Acarospora worthingtoniana* and on granite [Knudsen 19268a (SBBG)].

Differentiation. In California, the sympatric *Sarcogyne paradoxa* differs in apothecia with brown epihymenial accretions (Knudsen & Kocourková 2020). It is a lichenicolous fungus as well as sometimes forming a lichenized endolithic thallus.

Discussion. The first and second authors did extensive studies of *Acarospora destructans* in North America and published it under the misapplied names *Polysporina lapponica* (Ach. ex Schaer.) Degel. (Knudsen 2005, 2007) and later as *Polysporina subfuscescens* (Nyl.) K. Knudsen & Kocourk. (Knudsen & Kocourková 2009). In our study for our 2009 paper on lichenicolous *Polysporina* we found North American specimens differed from European specimens of *P.*

subfuscescens in having on average ascospores usually wider (usually 2.0–2.5 μm vs. 1.0–2.0 μm) (Knudsen & Kocourková 2009). Based on morphology and anatomy alone we were not confident treating the American material as separate species from the European species. Using an integrative taxonomic method, we now consider the main difference between *A. destructans* and the European *A. subfuscescens* is the North American taxon is pathogenic, destroying the host while the European taxon suppresses apothecia production in the host creating zombie lichens and is not usually pathogenic unless overpopulating the host (Knudsen et al. 2021b). Both species can be found in rock adjoining parasitized hosts. *Acarospora destructans* was recovered as *Polysporina species* No. 2 in Westberg et al. (2015) and as *Polysporina subfuscescens* in Knudsen et al. (2020, 2021a) in the *Acarospora* clade.

Acarospora eganiana K.Knudsen, Kocourk. & Hodková, sp. nov.

Fig. 2

MB842862

Type: U.S.A., New Mexico, 150 km east of Farmington, ca. 1800 m, on sandstone, 1987, *Haimo Pölzl s.n.* (GZU, holotype).

Diagnosis. Similar to *A. badiofusca* but differs in having a brown rather than black elevated margin, thinner paraphyses, 1.0–2.0 μm vs. 2.0–3.0 μm wide at mid-level, hemiamyloid hymenial vs. euamyloid hymenial gel, and thin to ellipsoid ascospores vs. usually broadly ellipsoid ascospores 3.0–5.0 \times 1.0–1.5(–2.0) μm vs. 4.0–6.0 \times 2.0–3.0 μm .

Description. Hypothallus endosubstratal, IKI-, no algae observed. Thallus dispersed to contiguous, covering several cm, areoles (0.2–)0.5–1.0(–1.3) mm wide, 300–350 μm thick when apothecia are immersed, (350–)400–500 μm thick when mature apothecia are elevated. Upper surface light brown, epruinose or pruinose, without fissures, apparently replicating by division. Epicortex ca. 10 μm thick. Cortex (20–)30(–40) μm thick, upper layer reddish brown, ca. 10 μm thick, lower layer hyaline, of articulated and vertical to disarticulated hyphae, 0.2–0.3 μm wide, apices up to 4 μm wide, POL-. Algal layer 70–120 μm thick, uninterrupted, and dense, extending below the apothecia. Medulla 100–150 μm thick, hyphae 2–4 μm wide, obscured in substrate crystals. Apothecia 0.2–1.3 mm wide, usually one per areole, beginning immersed, the parathecium expanding to form elevated apothecia, the margin brown, 50–100 μm wide, disc epruinose, rough, darker and usually level with the margin. Parathecium expanded around elevated apothecia to 50–100 μm wide, inner layer hyaline, narrow outer layer red brown, extending below edge of apothecium. Hymenium 90–120 μm tall, epihymenium 15–20 μm tall, reddish-brown, surface uneven, paraphyses (1.0–)1.5(–2.0) μm wide at midlevel, apices slightly expanded, usually in gel cap, usually with black pigment mark, hymenial gel when section thick IKI+ light blue, turning red in squash preparation, hemiamyloid. Asci 60–80 \times 18–22 μm , ascospores variable 3.0–5.0 \times 1.0–1.5(–2.0) μm thick, thin to ellipsoid. Subhymenium ca. 20 μm tall, IKI+ blue. Hypothecium (30–)40–60 μm thick. Not producing secondary metabolites. Pycnidia observed. Holotype: nrITS (OM522314), mtSSU (OM522316) nrLSU (OM572527).

Ecology and Distribution. Known only from the type locality in northern New Mexico 150 km east of Farmington, on sandstone at ca. 1800 m.

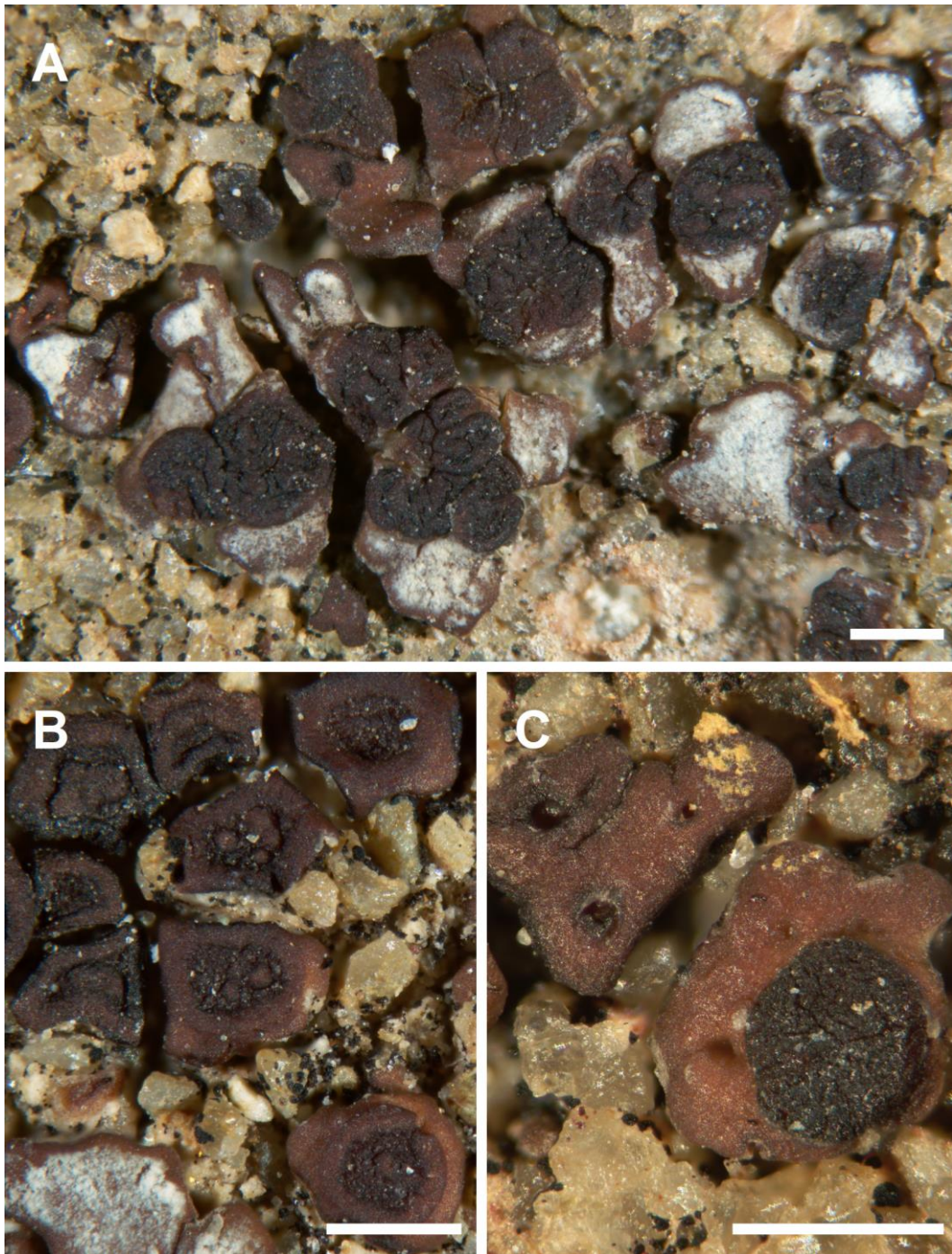


Fig. 2. *Acarospora eganiana*, holotype. A. habit of areolate, dispersed to contiguous, partly pruinous thallus with apothecia. B. Apothecia, disc epruinose, rough and darker than the margin. C. Elevated apothecium (right areole), pycnidia (left areole). Scale bars A=1 mm, B-C=0.5 mm.

Discussion. *Acarospora eganiana* belongs to a morphological group in which elevated apothecia are formed from an expanded parathecium like *A. admissa* or *A. badiofusca*. The species was discovered at Graz herbarium (GZU) in a specimen folder determined only to genus.

Acarospora worthingtoniana K.Knudsen, Kocourk. & Hodková, sp. nov. Fig. 3

MB842863

Type: U.S.A. New Mexico. Dona Aña Co., Organ Mountains, Baylor Pass Trail, 1790 m, 32.372223 -106.569856, on pink granitic rock, 9 March, 2020, K. Knudsen 19268a & J. Kocourková (SBBG, holotype).

Diagnosis. Similar to *Acarospora impressula* but differing especially in having hemiamyloid gel vs. euamyloid gel, thinner paraphyses 1.0 μm vs. stout paraphyses 2–3 μm thick at mid-level, and in having smaller ascospores 2–3 \times 1.0–1.5 μm vs. 3–4 (–5) \times 2–2.5 μm .

Etymology. Named in honor of the botanist R. D. Worthington of Texas, who collected many lichens in southern New Mexico.

Description. Hypothallus endosubstratal, IKI-, no algae observed. Thallus of irregular shaped areoles forming a contiguous crust, sometimes pseudo-lecanorine in the beginning, eventually with as many as 6 apothecia, all areoles fertile, 0.5–2 mm wide, ca. 300 μm thick, becoming distinctly elevated on mycelial base up to 0.5 mm high. Upper surface dull brown, epruinose. Lower surface white. Epicortex ca. 10 μm thick. Cortex ca. 20 μm thick, upper layer brown, one cell thick, lower layer hyaline, of disarticulated hyphae 2–4 \times 1 μm wide. Algal layer up to 200 μm thick between apothecia and continuous below apothecia, uninterrupted, dense, algal cells 10–12 μm wide. Medulla of intricate hyphae up to 4 μm thick, sometimes becoming constricted at septa and forming almost globose cells, continuous with mycelial base. Apothecia mostly 0.2 mm wide, disc reddish brown when wet, brown when dry, immersed to surrounded by elevated parathecial crown color of thallus, apothecia multiplying by division. Parathecium expanding around disc 40–120 μm . Hymenium 120–160 μm tall, epihymenium 10 μm thick, light brown, paraphyses 1 μm wide, apices unexpanded or in reddish brown gel caps with black pigment mark, hymenial gel IKI+ red, or blue to red, hemiamyloid. Asci 90–100 \times 16–20 μm , ascospores small mostly 2–3 \times 1.0–1.5 μm . Subhymenium 30–50 μm tall, IKI+ blue. Hypothecium 10–20 μm thick. Pycnidia not observed. Not producing secondary metabolites. Holotype: nrITS (OM522313), nrLSU (OM572526).

Distribution. This species is only known from the type locality on granite at 1790 m in full sun. Ecologically it occurs in the border of the Chihuahuan Desert Ecoregion with the Rocky Mountain ecozone in the Organ Mountains. When we collect species in this border area on the east side of the Organ Mountains, we consider them outliers of the Rocky Mountain flora (if not common at lower elevations). Thus, this species might be found in the sky islands of New Mexico extending to the mountains of Colorado and Utah and possibly in the sky islands of Arizona.

Discussion. This a member of a morphological *atrata* group of areolate contiguous crusts with flat to uneven surfaces and hemiamyloid hymenial gel.

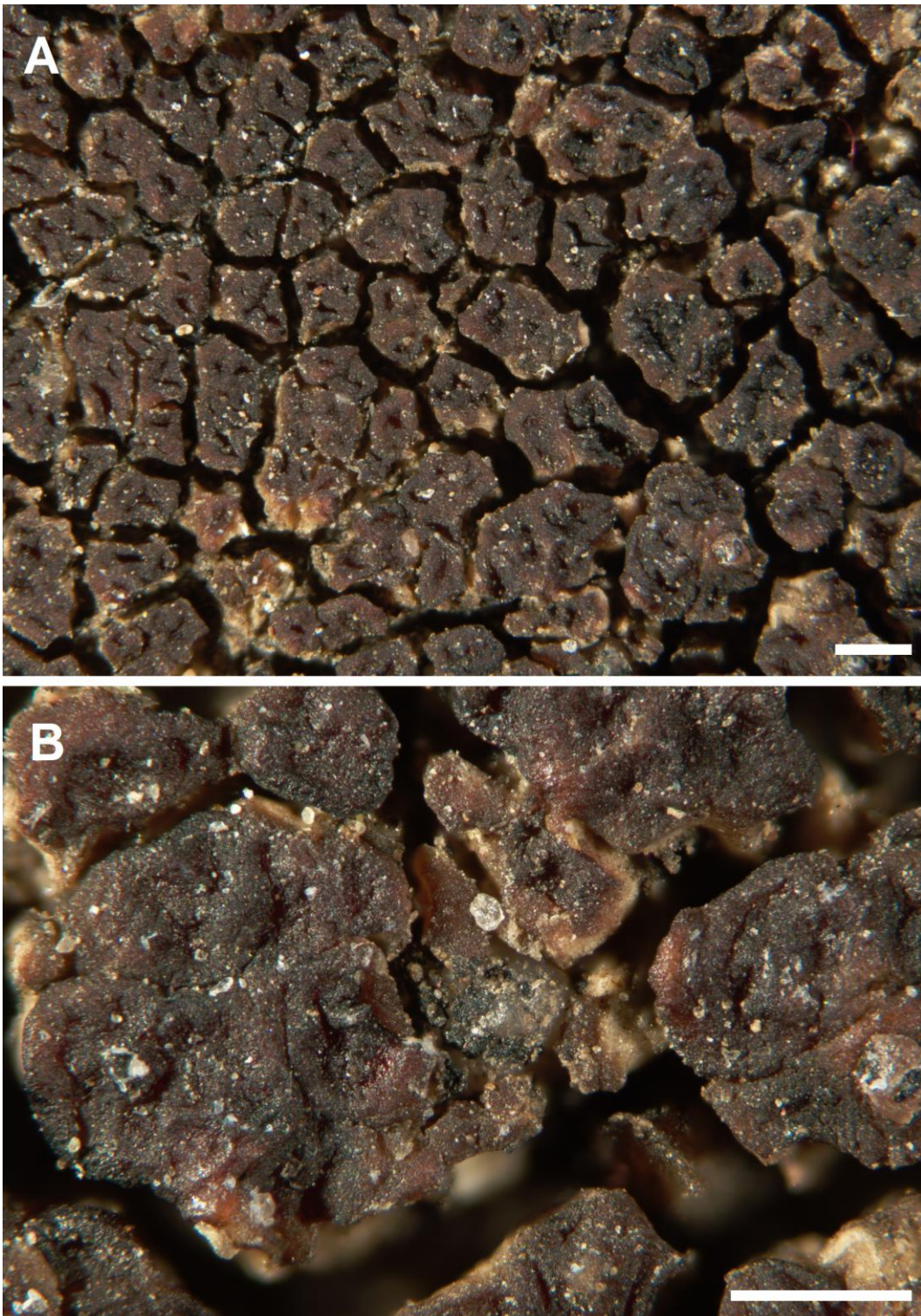


Fig. 3. *Acarospora worthingtoniana*, holotype. A. Habit of the thallus with apothecia. B. Detail of areoles covered with mature apothecia multiplied by division. Scales bars A, B=0.5 mm.

Sarcogyne melaniza (Nyl. ex Norrlin) K. Knudsen, Kocourk. & Hodková, comb. nov.

MB838830

Fig. 4

=*Lecanora glaucocarpa* var. *melaniza* Nyl. ex Norrlin, Meddeland. Soc. Fauna Fl. Fenn., Symbolae flor. Ladog. Karel. 2: 28 (1878)

TYPE: RUSSIA. Republic of Karelia: Ruskeala, on marble, 1874, *J.P. Norrlin s.n.* (H-NYL248892 holotype!).

=*Acarospora glaucocarpa* f. *melaniza* (Nyl.) H. Magn., Göteborg. Vetensk.-och Vitter.-Handl., Ser. 4, 28 (no. 2): 92 (1924)

Description. Thallus endolithic, algae usually in clusters in substrate or at base of apothecium, or in lower part of margin below the hypothecium and above the black lower surface algae 8–12 μm wide. Apothecia lecideoid, 0.5–2.0 mm wide, mostly 0.2–0.3 mm high, broadly attached when small, eventually forming a mycelial base narrower than lower black under surface of the apothecium, disc usually white pruinose, reddish brown when wetted, rarely partially pruinose to epruinose, usually flat in appearance, rarely convex. Margin black and epruinose, 90–150 μm wide, of radiating hyphae, melanized outer layer 60–100 μm thick, inner layer hyaline hyphae 1 μm wide. Algae sometimes absent, usually extending along lower inner edge of the margin. Hymenium (100–)140–150 μm high, epihymenium 10 μm or less, reddish brown, paraphyses mostly 2 μm wide at mid-level, apices barely expanded, hymenial gel IKI+ dark blue (euamyloid). Asci 100–120 \times 10–20 μm , ascospores ellipsoid to narrow ellipsoid, 3.0–5.0 \times 1.0–1.5 μm . Subhymenium 40–60 μm tall, IKI+ dark blue. Hypothecium up to 60 μm thick, interspersed with substrate crystals, continuous with attaching hyphae. Pycnidia not observed. No secondary metabolites detected. Sequences generated for this study: nITS (MW715695), mtSSU (MW715739), and nrLSU (MW 715728) from *Maliček 2240* (hb. Maliček).

Ecology and distribution. On calcareous rock in sun or partial shade, described from western Russia, and verified from Austria, the Czech Republic, Germany, and Norway. We recognize only these reports either seen by the authors or included in the phylogeny in Westberg et al. (2015). It has been our experience with forms and varieties not to accept any report in the literature.

Discussion. *Sarcogyne melaniza* differs from the common *S. regularis* in having a wider margin (100–150 μm vs. usually ca. 50 μm) and usually a higher hymenium (130–150 μm vs. 100–120 μm). *Sarcogyne melaniza* can be separated from specimens of *A. glaucocarpa* reduced to apothecia by the lack of a well-developed algal layer. Phylogenies in Westberg et al. (2015), Knudsen et al. (2020) and Knudsen et al. (2021a) all establish that specimens of *Acarospora glaucocarpa* var. *melaniza* are a separate lineage from *A. glaucocarpa*.

Specimens examined: CZECH REPUBLIC. Central Bohemia, distr. Česká Lípa, Mimoň, Hradčany, ‘Hradčanské stěny’, 290–350 m a. s. l., 50°37'20" N, 40°40'42" E on calcareous sandstone, 27. Jul. 2009, *J. Maliček 2240* & *Z. Palice* (hb. Maliček). GERMANY. Bavaria: (unreadable) nach Hochland, on calcareous rock, 20 Jul. 1941, *L. Laven s.n.* (BONN).



Fig. 4. *Sarcogyne melaniza*, J. Malíček 2240 & Z. Palice (hb. Malíček). Habit of the thallus of apothecia. Scale = 1 mm.

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