

Notes on the Genus *Sagediopsis* (Verrucariales, Adelococcaceae)

by

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Abstract:

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Notes on the genus *Sagediopsis* are given. *Sagediopsis dissimilis* Triebel is described as a new species and treated in detail. This lichenicolous fungus is confined to the lecideoid lichen *Paraporpidia leptocarpa* and occurs in Australasia. *Sagediopsis* is closely related to *Adelococcus*. Both genera are placed in a new family of the Verrucariales, Adelococcaceae Triebel. The family includes lichenicolous, non-lichenized taxa with persistent interascal filaments.

1. Introduction

The order Verrucariales Mattick ex D. Hawksw. & O. Eriksson includes until now only one family, the Verrucariaceae Zenker, which comprizes mainly lichenized ascomycetes. It is characterized by globose, mainly clypeate and at least apically dark brown perithecioid ascomata. The hamathecial elements are confined to the ostiolar canal. The asci of the *Verrucaria*-type are broadly clavate, apically equally thick-walled and have constantly non-amyloid inner wall layers (see ERIKSSON 1981, HAWKSWORTH & ERIKSSON 1986). The hymenial gel and the external ascus wall layer frequently turn red in Lugol's iodine solution.

The majority of the c. 800 known Verrucariacean taxa develops two-biont lichen associations. Only a few lichenicolous lichens establishing three-biont associations are known (RAMBOLD & TRIEBEL 1992, checklist C). Just recently, some groups of non-lichenized fungi with lichenicolous, algicolous or hepaticolous life habit were placed in the order Verrucariales. These are the genera *Endococcus* Nyl., *Merismatium* Zopf, *Muellerella* Hepp ex Müll. Arg., *Norrlinia* Theissen & Sydow, and *Phaeospora* Hepp (ERIKSSON & HAWKSWORTH 1985, 1990, 1991, MATZER 1993a, MATZER & HAFELLNER 1990, TRIEBEL 1989). Also the genus *Lauderlindsaya* J.C. David & D. Hawksw. which was recently described (DAVID & HAWKSWORTH 1989) belongs to the Verrucariales and may comprize lichenicolous fungi. The biological behaviour of its species, however, and the acceptance of *Lauderlindsaya* is still discussed controversially (APTROOT 1989, DIEDERICH et al. 1991, DIEDERICH & SÉRUSIAUX 1993). The six genera with lichenicolous fungi mentioned above, belong according to their ascomatal and hymenial characters to the family Verrucariaceae.

MATZER & HAFELLNER (1990) enlarged the concept of the Verrucariales in that they placed a genus of lichenicolous fungi with more or less persistent interascal filaments, *Adelococcus* Theissen & Sydow, in this order. The genus *Sagediopsis* (Sacc.) Vainio is considered here as a further Verrucariacean genus with lichenicolous fungi, which is most closely related to *Adelococcus*. The characters which separate the Verrucariacean genera with lichenicolous fungi are given in table 1.

Tab. 1: Characters separating Verrucariales genera with lichenicolous fungi [hal = halonate, sm = smooth, sr = slightly roughened]; for literature see DAVID & HAWKSWORTH (1989), DIEDERICH & SÉRUSIAUX (1993), HAWKSWORTH (1980), MATZER (1993a, b), MATZER & HAFELLNER (1990), ØVSTEDAL & HAWKSWORTH (1986), RAMBOLD et al. (1990), SANTESSON (1989), TRIEBEL (1989).

Genus (accepted species)	para- physoids	spores per ascus	ascospore pigmentation	spore septa transverse/ vertical	peri-/epi- spore structure
<i>Adelococcus</i> (2)	+	8	+	0-1/0	sr
<i>Endococcus</i> (8)	-	(4-) 8	+	1/0	sm/sr
<i>Lauderlindsaya</i> (3)	-	8	- (+)	3-7/0-1	sm
<i>Merismatium</i> (7)	-	8	+	3-9/0-3	sm/hal
<i>Muellerella</i> (8)	-	16-∞	+	0-4/0	sm/sr
<i>Norrlinia</i> (1)	-	2	-	12-20/0-7	sm
<i>Phaeospora</i> (3)	-	8	- (+)	3/0	hal
<i>Sagediopsis</i> (5)	+	8	- (+)	0-7/0	sm

2. The Genus *Sagediopsis*

The name *Sagediopsis* was introduced by SACCARDO (1905) as a subgenus of *Metasphaeria* Sacc. There it was used for lichenicolous pyrenomycetes with eight 2- to pluriseptate, hyaline ascospores per ascus and distinct interascal filaments. VAINIO (1921) raised it to generic status. This was not taken up by later authors, e.g. KEISSLER (1930). Meanwhile, *Sagediopsis* (Sacc.) Vainio has been reestablished and its generic concept has since been clarified (TRIEBEL 1989). *Leptorhaphis koerberi* B. Stein, growing on *Koerberiella wimmeriana* (Koerb.) B. Stein, was selected as the type species of *Metasphaeria* subg. *Sagediopsis* Sacc. by THEISSEN & SYDOW (1918: 28). TRIEBEL (1989: 109, 112) designated a neotype specimen for *Leptorhaphis koerberi* and found it to be a later taxonomic synonym of *Gongylia aquatica* B. Stein. The lectotype specimen of *Sagediopsis aquatica* (B. Stein) Triebel was found on a sterile crustose thallus which proved to be morphologically and chemically identical with *Koerberiella wimmeriana* (RAMBOLD et al. 1990).

The genus now comprizes lichenicolous species with relatively large, dark brown perithecioid ascomata and a characteristic pseudoparenchymateous ascomata wall structure. All species show more or less distinct paraphysoids, numerous periphysoids and periphyses. A characteristic hemiamyloid reaction of the hymenial gel is always observable, i.e. the gel turns red to red-violet in Lugol's iodine solution (Merck 9261; old herbarium specimens may react dirty bluish) and bluish in Lugol's solution, diluted 1:6. The asci are of the *Verrucaria*-type (i.e. clavate, thick-walled, mainly without a distinct internal beak) and 8-spored. The ascospores show a great variation with respect to their shape and number of septa. The type species (*S. aquatica*) and a second species (*S. barbara*) have narrowly fusiform to acicular, 3 (-7)-septate ascospores, whereas *S. campsteriana* and *S. fissurisedens* have ellipsoid, 3 (-4)-septate ascospores. Here, a further species is included. It has 0-1-septate, ellipsoid to ovoid ascospores but fits with the generic delimitation in all other features. The genus comprizes the following five species which can easily be distinguished by their host selection and ascospore measurements.

Sagediopsis aquatica (B. Stein) Triebel= *Gongylia aquatica* B. Stein= *Leptorhaphis koerberi* B. Stein

Host lichen: *Koerberiella wimmeriana* (Koerb.) B. Stein; ascospores narrowly fusiform to acicular, (0-) 3 (-6)-septate, (22-) 27-36 (-45) × (2.5-) 3-3.5 (-4) μm; for description see RAMBOLD et al. (1990); for nomenclature see AGUIRRE-HUDSON (1991 – sub *Leptorhaphis koerberi*), RAMBOLD et al. (1990), TRIEBEL (1989).

Sagediopsis barbara (Th. Fr.) R. Sant. & Triebel= *Leptorhaphis steinii* Koerb.= *Gongylia nadvornikii* Servit= *Gongylia norvegica* H. Magn.

Host lichen: *Porpidia glaucophaea* (Koerb.) Hertel & Knoph; ascospores narrowly fusiform to acicular, (0-) 3 (-7)-septate, (20-) 27-39.5 (-46) × (3-) 3.5-4.5 (-5) μm; for description and nomenclature see AGUIRRE-HUDSON (1991 – sub *Leptorhaphis steinii*), TRIEBEL (1989).

Sagediopsis campsteriana (Lindsay) D. Hawksw. & R. Sant.= *Metasphaeria tartarina* (Nyl.) Keissl.

Host lichens: *Ochrolechia frigida* (Sw.) Lyngé, *O. lapuensis* (Räs.) Räs., *O. tartarea* (L.) Massal., *Ochrolechia* sp. Reports on *Lecanora hageni* (Ach.) Ach., e.g. by VEZDA (1970), should be confirmed by additional material. Reports on *Lecidea cinnabarina* Sommerf. must be rejected (HAFELLNER in litt.; TRIEBEL 1989); ascospores ellipsoid, (1-) 3 (-4)-septate, (12-) 15-20 (-25) × 4-6 μm; for description see HAWKSWORTH (1975 – sub *Metasphaeria tartarina*), VEZDA (1970 – sub *Metasphaeria tartarina*); for nomenclature see ALSTRUP & HAWKSWORTH (1990), TRIEBEL (1989).

Sagediopsis dissimilis Triebel

Host lichen: *Paraporpidia leptocarpa* (Bab. & Mitt.) Rambold & Hertel; ascospores ellipsoid to ovoid, 0-1-septate, (7.5-) 8-10.5 (-12) × (4-) 4.5-6 (-6.5) μm; for description see further below.

Sagediopsis fissurisedens Hafellner ined.

Host lichen: *Aspicilia myrinii* (Fr.) B. Stein; ascospores ellipsoid, (1-) 2-3-septate, 12-17 × 5-8 μm; for description see HAFELLNER (in prep.).

All species of *Sagediopsis* so far known are highly specialized with respect to their hosts and confined on one species or one genus. The host lichens are saxicolous or terricolous, and develop thick crusts over acid substrates. The members of *Sagediopsis* are found in extra-tropical regions of the Northern Hemisphere, and, with *S. dissimilis*, also for the first time in the Southern Hemisphere.

3. The Species *Sagediopsis dissimilis*

Sagediopsis dissimilis Triebel – sp. nov.

Diagnosis: Ascomata perithecioida, 0.15-0.25 mm in diametro, globosa vel pyriformia, atra, immersa, in thallis lichenis *Paraporphidia leptocarpa* vigentia. Apices ascomatum applanatae, ostiolo circa 15-30 μm in diametro. Paries ascomatum apicaliter fuscus, incrassatus, basaliter subfuscus, pseudoparenchymaticus, circa 25-35 μm crassus, e 7-10 stratis cellularum compositus. Cellulae circa 4.0-5.0 μm in diametro (lumina 2.0-3.5 μm). Subhymenium incoloratum. Gelatina hymenii in solutione $\text{ILugol}1:6$ dicta coerulescens, in solutione ILugol dicta rubescens. Periphysoides raro ramosae, circa 1.5 μm crassae (lumina circa 1.0 μm), paraphysoides raro ramosae, circa 1.0-1.5 μm crassae (lumina circa 1.0 μm). Asci clavati, crassitunicati, circa 35-48 μm longi et 10-11 μm lati, octospori. Ascosporae (7.5-) 8-10.5 (-12) \times (4-) 4.5-6 (-6.5) μm magnae, late ellipsoidales vel ovoideae, non septatae vel uniseptatae, (septum pro parte amediatum et leviter curvatum). Paries ascosporarum incoloratus, raro subfuscus, circa 0.5-1.0 μm crassus, perisporio laevi.

Type: Australia: Queensland: Mt Coolum, c. 90 km N of Brisbane, 26°34'S, 153°05'E, basaltic outcrops near summit in low heath, c. 180 m, 11 February 1986, *G. Rambold 4418* (M, holotypus).

Ascomata perithecioid, 0.15-0.25 mm diam., globose to pyriform, black, immersed in the thallus of *Paraporphidia leptocarpa*, eruptent. Apices of the ascomata more or less plane, ostiolum obvious, c. 15-30 μm diam. Ascomata wall apically up to 80 μm thick, brown to dark brown, at the base brown to pale brown, pseudoparenchymateous, 25-35 μm thick, composed of 7-10 cell layers; (see fig. 1a). Cells c. 4.0-5.0 μm diam. (lumina 2.0-3.5 μm), with irregularly thickened cell walls and small lumina. Hyphae around ostiolum elongated. Subhymenium colourless. Hymenial gel hemiamyloid, i.e. $\text{ILugol}1:6$ + bluish, ILugol + red or red-violet. IMelzer –. Hamatecium consisting of periphyses, periphysoids and paraphysoids. Periphysoids cellular, rarely branched, embedded in gel, c.1.5 μm thick (lumina 1.0 μm). Paraphysoids numerous, scarcely septate, rarely branched, c. 1.0-1.5 μm thick (lumina 1.0 μm) (see fig. 1b). Asci clavate, thick-walled (wall apically c. 2.5 μm thick), 35-48 \times 10-11 μm , 8-spored (see fig. 1c). Ascospores (7.5-) 8-10.5 (-12) \times (4-) 4.5-6 (-6.5) μm , broadly ellipsoid to ovoid, 0-1-septate, (septum sometimes slightly curved and amediate), colourless, rarely pale brown, often with 1-2 oil drops, thick-walled (c. 0.5-1.0 μm thick), with smooth perisporium (see fig. 1d).

Hosts: *Paraporphidia leptocarpa* (Bab. & Mitt.) Rambold & Hertel.

Distribution: Known from Australia and New Zealand (see fig. 2).

Further specimens examined:

Australia: Queensland: Bellenden Ker Range, Bartle Frere North West Peak, 17°23'S, 145°48'E, exposed outcrops below peak, c. 1500 m, 1 March 1986, *G. Rambold 4839* (M). – Crystal Creek National Park, Paluma, 19°00'S, 146°13'E, exposed rocks at Witt's Lookout, c. 900 m, 25 February 1986, *G. Rambold 4799* (M). – New South Wales: New England National Park, Point Lookout, 30°29'S, 152°25'E, boulders in dry sclerophyll forest, 1530 m, 6 February 1986, *G. Rambold 4319* (UPS), 4327, 4328 (M). – New England National Park, Lyrebird Track, 30°30'S, 152°24'E, boulders in heath with *Banksia*, 1400 m, 6 February 1986, *G. Rambold 4349* (M). – Barrington Tops National Park, Gloucester Tops, Negrohead Beech Forest Walking Trail, 32°05'S, 151°35'E, mossy low boulders in temperate rainforest with *Nothofagus moorei*, c. 1200 m, 4 February 1986, *G. Rambold 4236* (M). – Blue Mountains National Park, near Glenbrook, c. 60 km W of Sydney, 33°46'S, 150°37'E, September

1981, *M. Mayrhofer 3269* (GZU). – Peakhurst near Sydney, 33°53'S, 151°13'E, 23 September 1900, [no collector] (BRI 354951). – Morton National Park, 8 km E of Nerriga, 35°05'S, 150°08'E, boulders in open *Eucalyptus* forest, 750 m, 23 January 1986, *G. Rambold 3904* (M). – Victoria: Great Dividing Range, Hanging Rock E of Woodend, about 70 km NE of Melbourne, volcanic rocks, 37°22'S, 144°40'E, c. 500 m, 18 July 1986, *J. Hafellner 15755* & *R. Filson* (hb. Hafellner). – Cathedral Range, Mt Sugarloaf, 37°31'S, 147°42'E, on siliceous rocks, 800 m, 12 September 1987, *H.T. Lumbsch 5655* g (hb. Lumbsch). – "On sandstone rock by stream Lorne ...", 38°32'S, 143°58'E, May 1887, *F.R.M. Wilson* (NSW 155924). – New Zealand: South Island: Canterbury: Mt Peel, Lynn Stream Valley, Long Speer above Acland's hut, 43°50'30"S, 171°11'E, 15 January 1985, *H. Hertel 29431* (M).

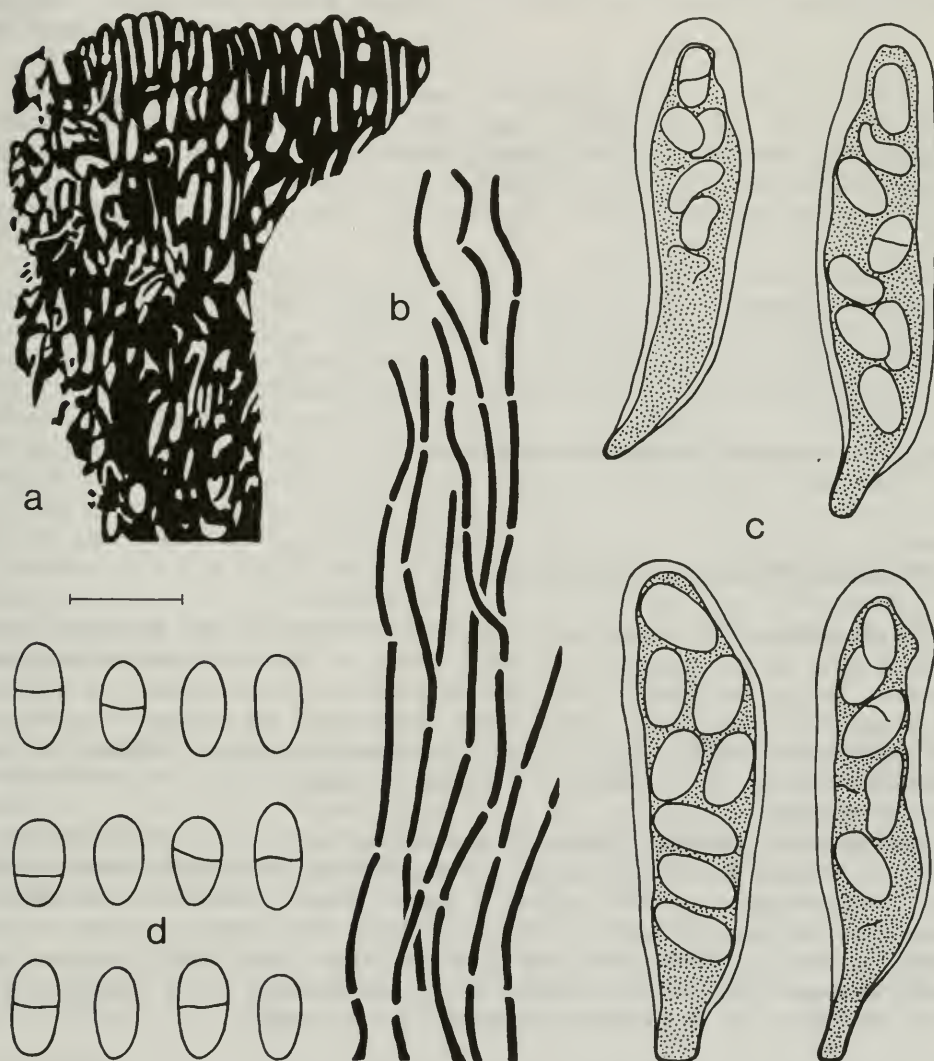


Fig. 1: *Sagediopsis dissimilis*: a) apical part of the ascomata wall; b) paraphysoids; c) asci; d) ascospores [a, c, d: in H₂O; b: in lactophenol cotton blue; *H. Hertel 29431* (M)]. – Scale: a: 18 µm; b-d: 10 µm.



Fig. 2: The distribution of *Sagediopsis dissimilis*.

4. The Natural Relationship of *Sagediopsis*

The genus *Sagediopsis* is most closely related to *Adelococcus* Theissen & Sydow. Up to now the latter genus comprises two species occurring on crustose lichens on calciferous substrates: *Adelococcus alpestris* (Zopf) Theissen & Sydow, found on species of *Acarospora* (*A. glaucocarpa* (Ach.) Koerb., *A. macrospora* (Hepp) Bagl.) and *Adelococcus interlatens* (Arnold) Matzer & Hafellner which grows on *Clauzadea immersa* (Web.) Hafellner & Bellem., *Hymenelia prevostii* (Duby) Kremp. and *Sarcogyne regularis* Koerb. coll. (MATZER & HAFELLNER 1990).

Adelococcus and *Sagediopsis* have similar ascomata wall structures, develop periphyses and numerous persistent paraphysoids, more or less persistent paraphysoids, thick-walled asci of the *Verrucaria*-type (i.e. mainly without a distinct internal apical beak) and show a characteristic hemiamyloid reaction of the hymenial gel. Distinguishing characters concern mainly spore features. Mature ascospores of *Adelococcus* are brown, slightly roughened and mostly nonseptate, whereas those of *Sagediopsis* are smooth-walled, mostly colourless and at least 1-septate (see tab. 1). Both genera are included in a new family.

Adelococcaceae Triebel – fam. nov.

Diagnosis: Ascomycetes ordinis Verrucariales lichenicoli, non-lichenisati. Ascomata perithecioidea, globosa vel pyriformia, atra. Paries ascomatum apicaliter fuscus, incrassatus,

basaliter fuscus vel subfuscus, pseudoparenchymaticus. Gelatina hymenii hemiamyloidea, i.e. in solutione $IL_{Ugol}1:6$ dicta coerulescens, in solutione IL_{Ugol} dicta rubescens. Periphyses et periphysoides numerosae, distinctae. Paraphysoides plus minusve distinctae. Asci clavati aut late cylindrici, crassitunicati, typo *Verrucaria* dicto.

Typus familiae: *Adelococcus* Theissen & Sydow – *A. alpestris* (Zopf) Theissen & Sydow.

A family of the order Verrucariales, hitherto comprizing lichenicolous, non-lichenized taxa. Ascomata perithecioid, globose to pyriform, black. Ascomata wall apically dark brown, thickened, basally dark brown to pale brown; pseudoparenchymateous. Hymenial gel hemiamyloid, i.e. $IL_{Ugol}1:6$ + bluish, IL_{Ugol} + red to red-violet. Periphyses and periphysoids numerous, distinct. Paraphysoids more or less distinct. Asci clavate or broadly cylindrical, thick-walled, of the *Verrucaria*-type.

The family Adelococcaceae includes the genera *Adelococcus* and *Sagediopsis*. Both genera exhibit characters regarded as primitive in the Verrucariales, like the occurrence of paraphysoids and the simple pseudoparenchymateous, aclypeate ascomata wall structure. These features correlate with the lichenicolous habit. The majority of Verrucarialean taxa is currently placed in the type family Verrucariaceae, which is considered still to comprize heterogenous elements.

The badly known, lichenized genus *Discocera* A.L. Sm. & Ramsb. may be related to the Adelococcaceae, as its only species *D. lichenicola* A.L. Sm. & Ramsb. has distinct periphysoids and paraphysoids, the characteristic hemiamyloid reaction of the hymenial gel and asci of the *Verrucaria*-type (RAMBOLD & TRIEBEL 1990, fig. 2d). Lichenicolous fungi which superficially resemble lichenicolous Verrucarialean taxa are currently placed in the Dothidealean families Dacampiaceae Koerb. (= Pyrenidiaceae A. Zahlbr.) and Mycosphaerellaceae G. Lindau. Both families include taxa which generally have non-amyloid, fissitunicate asci with a distinct internal apical beak, show no hemiamyloid reactions of the hymenial gel and no periphysoids. Their species may develop short periphyses confined to the ostiolar canal. The Dacampiaceae (e.g. *Dacampia* Massal., *Polycoccum* Sauter ex Koerb., *Pyrenidium* Nyl.) have distinct interascal filaments, whereas those of the lichenicolous taxa currently placed in the Mycosphaerellaceae (e.g. *Echinothecium* Zopf, *Sphaerellothecium* Zopf, *Stigidium* Trev.) are lacking or soon becoming evanescent. Both families still include heterogenous elements.

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