

Two new records and a revised key to the saxicolous species of *Rinodina* in Australia

John A. Elix

Research School of Chemistry, Building 137,
Australian National University, Canberra, A.C.T. 2601, Australia
e-mail: John.Elix@anu.edu.au

Abstract

Rinodina herteliana Kaschik and *R. teichophiloides* (Stizenb.) Zahlbr. are reported for the first time from Australia, while *R. argopsina* Elix & P.M. McCarthy is shown to be a synonym of *R. thiomela* Müll. Arg. An updated key to the saxicolous Australian species of *Rinodina* is provided.

Introduction

The saxicolous species of *Rinodina* (Ach.) S.F. Gray in Australia are relatively well known following the initial treatment by Mayrhofer (1984), further additions by Mayrhofer *et al.* (1990), Matzer & Mayrhofer (1994), Matzer *et al.* (1998) and Trinkaus *et al.* (1999), and the more recent revisions by Kaschik (2006) and Elix (2011), as well as the recognition of four additional species (Elix & Giralt 2015; Mayrhofer & Elix 2018; Elix *et al.* 2019; Grube *et al.* 2019). This note documents the recent discovery of *R. herteliana* growing on siliceous rocks in Victoria, a species previously known from the South Island of New Zealand (Kaschik 2006), and *R. teichophiloides* growing on siliceous rocks in south-eastern Australia, previously known from similar substrata in South Africa (Matzer & Mayrhofer 1994, 1996).

New records

1. *Rinodina herteliana* Kaschik, *Biblioth. Lichenol.* **93**, 57 (2006)

Figs 1, 2

Type: New Zealand, South Island, summit of Silver Peak (Pulpit Rock), W of Watati, 45°45'S, 170°26'30"E, 750–760 m alt., on schist, *H. Mayrhofer 13473*, *H. Hertel & G.T. Baylis*, 29.i.1985 (holotype – GZU, not seen).

Thallus to 50 mm wide and 0.5 mm thick, crustose, immersed or rimose-areolate or verrucose-areolate; individual areoles 0.1–0.3 mm wide, to 0.15 mm thick; upper surface olive-brown to grey-brown or yellow-brown, ± granular; prothallus not apparent; medulla white, lacking calcium oxalate (H₂SO₄-), I-; photobiont cells 7–12 µm in diam. *Apothecia* 0.2–0.8 mm wide, scattered or crowded, pseudolecanorine to lecideine, broadly adnate to sessile; disc black, epruinose, plane to weakly convex; thalline exciple raised above the disc at first, becoming thinner and excluded in older apothecia. *Proper excipulum* dark brown, persistent, in section 20–30 µm thick, outer zone dark brown, K+ red, N+ orange, inner zone paler brown. *Ephymenium* 10–20 µm thick, brown, K-, N-. *Hypothecium* 70–80 µm thick, colourless, interspersed with oil droplets, K-. *Hymenium* 75–100 µm thick, colourless, not interspersed. *Paraphyses* 1.5–2 µm wide, simple to branched, capitate, the apices 3–4 µm wide with brown caps. *Asci* *Lecanora*-type, 8-spored. *Ascospores* *Physcia*-type transitioning into *Mischoblastia*- and *Pachysporaria*-types, 1-septate, brown, broadly ellipsoid, 15–[19.7]–23 × 8–[12.1]–14 µm, torus ± well developed; ontogeny of type-A; outer spore-wall finely ornamented. *Pycnidia* pyriform, immersed, brown to brown-black; conidia bacilliform, 4–5 × 1–1.5 µm. *Chemistry*: Thallus K-, C-, KC-, P-, UV-; proper excipulum K+ red; containing cinnamomeic acid C (major).

Remarks

This species was known previously from the South Island of New Zealand (Kaschik 2006). It is characterized by the immersed to superficial, olive-brown to grey-brown or yellow-brown crustose thallus, the pseudolecanorine to lecideine apothecia, a dark brown,

K+ red excipulum, *Physcia*-type ascospores transitioning into *Mischoblastia*- and *Pachysporaria*-types, 15–23 × 8–14 µm, and the presence of cinnamomeic acid C.

SPECIMEN EXAMINED

Victoria: ● Trentham Falls, c. 20 km E of Daylesford, NE of Melbourne, 37°23'S, 144°19'30"E, 450 m alt., on rock outcrops in gorge N of falls, *J. Hafellner 15743a & R. Filson*, 18.vii.1986 (GZU).

2. *Rinodina teichophiloides* (Stizenb.) Zahlbr., *Cat. Lich. Univ.* **7**, 557 (1931) Figs 3, 4 *Lecanora teichophiloides* Stizenb., *Bericht über die Thätigkeit der St. Gallischen Naturwissenschaftlichen Gesellschaft* **1888/1889**, 212 (1890).

Type: South Africa, Western Cape, supra saxa quartzosa ad Muizenberg in Promontorio Bonae Spei, *MacOwan 126* (holotype – ZT, not seen).

Thallus to 65 mm wide and 0.5 mm thick, crustose and rimose-areolate or subsquamulose; individual areoles 0.2–1 mm wide, to 0.5 mm thick, contiguous or dispersed; upper surface matt, smooth, esorediate, pale grey to yellow-brown, grey-brown or dark brown; prothallus marginal, brown or not apparent; medulla white, lacking calcium oxalate (H₂SO₄-), I-; photobiont cells 10–16 µm in diam. *Apothecia* 0.2–0.8 mm wide, scattered, lecanorine to cryptolecanorine, immersed to broadly adnate; disc brown to black, epruinose, plane to weakly convex; thalline exciple raised above the disc at first, becoming thinner and excluded in older apothecia. *Proper excipulum* greenish black, persistent, in section 25–35 µm thick, outer zone dark brown to aeruginose, N- or N+ purple-brown, inner zone paler brown. *Ephymenium* 10–30 µm thick, dark brown, K-, N-. *Hypothecium* 100–150 µm thick, colourless to pale yellow or yellow-brown, K+ yellow solution or K-. *Hymenium* 90–130 µm thick, colourless, not interspersed. *Paraphyses* 1.5–2 µm wide, simple to branched, capitate, with apices 3–5 µm wide and brown caps, with scattered oil paraphyses 4–6 µm wide. *Asci* *Lecanora*-type, 2–8-spored. *Ascospores* *Teichophila*-type (with internal wall thickenings transitioning from *Pachysporaria*- to *Milvina*- or *Mischoblastia*-types at different stages of development), 1-septate, brown, broadly ellipsoid, (17–)20–[25.1]–32 × 10–[13.9]–18 µm, often dilated at the septum, torus absent; ontogeny of type-A; outer spore-wall finely ornamented. *Pycnidia* pyriform, immersed, brown to brown-black; conidia bacilliform, 4–5 × 1–1.5 µm. *Chemistry*: Thallus K-, C-, KC-, P-, UV-; no lichen substances detected by TLC.

Remarks

In many respects this species closely resembles *R. reagens* Matzer & H. Mayrhofer. Both have immersed to adnate, lecanorine to cryptolecanorine apothecia, similar-sized ascospores and ascospore ontogeny, and they lack lichen substances. However, *R. reagens* invariably contains a yellow-green hypothecial pigment that yields a K+ yellow to orange solution, and it is restricted to calcareous substrata (Matzer & Mayrhofer 1994, 1996). The differentiation of *R. teichophiloides* from the related Northern Hemisphere *R. teiochophila* (Nyl.) Arnold has been discussed in detail by Matzer & Mayrhofer (1994).

SPECIMENS EXAMINED

New South Wales: ● Tinderry Mountains, 5 km S of Tinderry Peak, 35°44'S, 149°17'E, 1215 m alt., on granite rocks in dry sclerophyll forest, *J.A. Elix 5464*, 12.xi.1978 (CANB).

Australian Capital Territory: ● Along the Molonglo River, 0.5 km W of Coppins Crossing, 8.5 km W of Canberra, 35°17'17"S, 149°01'58"E, 530 m alt., on porphyry rock outcrops in pasture, *P.M. McCarthy 4847*, 30.i.2019 (CANB); ● Kowen Road, Kowen Forest, 11.7 km E of Canberra, 35°19'02"S, 149°15'07"E, 700 m alt., on sandstone rocks in open *Eucalyptus* woodland, *P.M. McCarthy 4862*, 31.vii.2019 (CANB).

Tasmania: ● N end of Godfreys Beach, Stanley, 40°45'S, 145°18'E, 1 m alt., on seashore basalt rocks, *G. Kantvilas 169/19*, 13.v.2019 (HO).

A new synonym

Rinodina thiomela (Nyl.) Müll.Arg., *Flora* **64**, 515 (1881)

Synonym: *Rinodina argopsina* Elix & P.M.McCarthy, in Elix *et al.*, *Australas. Lichenol.* **84**, 10 (2019).

Remarks

Rinodina argopsina Elix & P.M.McCarthy was recently described as being characterized by a crustose, pale whitish green to yellow-green thallus, lecanorine apothecia, 0.2–0.7 mm wide, 1-septate, olive-brown then brown, ellipsoid, *Teichophila*-type ascospores (with internal wall thickenings grading from *Pachysporaria*-type to *Milvina*-, *Physcia*- and *Mischoblastia*-types at different stages of development), 18–30 × 10–17 µm, and the presence of argopsin, zeorin and traces of thiomelin (Elix *et al.* 2019). The reported occurrence of argopsin in this specimen was erroneous, because in fact it came from a co-occurring *Lecidella* species and is absent in uncontaminated *Rinodina* specimens. As a consequence, the morphology, anatomy and chemistry of the type specimen of *R. argopsina* are consistent with those of *R. thiomela*.

Key to Australian species of *Rinodina* growing on rocks or on saxicolous lichens

[for illustrations of spore types and ontogeny see Kaschik (2006) and Sheard (2010)]

- 1 Thallus lichenicolous 2
- 1: Thallus autonomous 3
- 2 Ascospores 18–25 × 11–15 µm, *Milvina*-type **R. milvinodes**
- 2: Ascospores 13–21 × 7–12 µm, *Pachysporaria*-type **R. williamsii**
- 3 Thallus yellow or yellow-grey; ascospores *Teichophila*-type 4
- 3: Thallus grey or brown; ascospores various 8
- 4 Hypothecium brown to deep yellow-brown; 6-*O*-methylarthothelin present **R. michaelae**
- 4: Hypothecium colourless to pale yellow-brown; arthothelin and/or thiomelin present... 5
- 5 Thiomelin (major) present; arthothelin absent 6
- 5: Arthothelin (major) present; thiomelin present in minor or trace amounts 7
- 6 Apothecia immersed; ascospores 14–21 × 7–11 µm; subtropical to mainly tropical **R. xanthomelana**
- 6: Apothecia adnate to sessile at maturity; ascospores 20–34 × 11–17 µm; mainly temperate to subtropical **R. thiomela**
- 7 2,5-Dichlorolichexanthone, 4,5-dichlorolichexanthone ± lichexanthone present; ascospores 10–14 µm wide **R. tenniswoodiorum**
- 7: Dichlorolichexanthones and lichexanthone absent; ascospores 11–20 µm wide **R. arthomelina**
- 8 Thallus on calcareous rocks 9
- 8: Thallus on siliceous rocks 13
- 9 Apothecia immersed; hymenium not inspersioned with oil droplets **R. immersa**
- 9: Apothecia not immersed; hymenium inspersioned with oil droplets or not 10
- 10 Ascospores *Bischoffii*-type; hymenium usually inspersioned with oil droplets **R. bischoffii**
- 10: Ascospores not *Bischoffii*-type; hymenium not inspersioned 11

- 11 Ascospores *Bicincta*-type **R. luridata**
- 11: Ascospores not *Bicincta*-type 12
- 12 Ascospores *Teichophila*-type; spore walls finely scabrid **R. reagens**
- 12: Ascospores *Tunicata*-type; spore walls striate **R. stratunicata**
- 13 Excipulum K+ red or violet; cinnamomeic acid C present **R. herteliana**
- 13: Excipulum K–; cinnamomeic acid C absent 14
- 14 Thallus K+ yellow; atranorin present 15
- 14: Thallus K– or endolithic; atranorin absent 22
- 15 Ascospores *Physcia*- or *Milvina*-type transitioning to *Physcia*-type 16
- 15: Ascospores not *Physcia*-type or *Milvina*-type transitioning to *Physcia*-type 18
- 16 Ascospores 11–16 × 5–9 µm **R. occulta**
- 16: Ascospores 15–27 × 8–13 µm 17
- 17 Ascospores *Physcia*-type, 15–27 × 8–13 µm; pannarin absent **R. confragosa**
- 17: Ascospores *Milvina*-type transitioning to *Physcia*-type, 16–22 × 10–13 µm; pannarin present **R. murrayi**
- 18 Ascospores *Pachysporaria*-type transitioning to *Milvina*-type, 14–20 × 7–12 µm **R. substellulata**
- 18: Ascospores *Mischoblastia*-type transitioning to *Pachysporaria* and *Physcia*-types... 19
- 19 Apothecia lecanorine 20
- 19: Apothecia lecideine to pseudolecanorine (or rarely lecanorine) 21
- 20 Ascospores 15–21 × 9–11 µm; gyrophoric acid present **R. gyrophorica**
- 20: Ascospores 18–27 × 10–15 µm; gyrophoric acid absent... **R. moziana** var. **moziana**
- 21 Excipulum containing an aeruginose, N+ red or purple pigment **R. oxydata**
- 21: Excipulum lacking an aeruginose, N+ red or purple pigment **R. oxydatella**
- 22 Thallus isidiate or blastidiate 23
- 22: Thallus not blastidiate or isidiate 24
- 23 Thallus isidiate **R. austroisidiata**
- 23: Thallus blastidiate **R. blastidiata**
- 24 Ascospores *Dirinaria*-type transitioning to *Physconia*-type, 11–19 × 6–11 µm **R. oleae**
- 24: Ascospores not *Dirinaria*-type transitioning to *Physconia*-type 25
- 25 Ascospores *Physconia*-type, 12–27 × 8–15 µm; medulla yellow-orange, K+ red in part; skyrin present **R. peloleuca**
- 25: Ascospores not *Physconia*-type; medulla white; skyrin absent 26
- 26 Ascospores *Physcia*- or *Physcia*-type transitioning to *Milvina*-type 27
- 26: Ascospores *Pachysporaria*-, *Teichophila*- or *Tunicata*-type 28
- 27 Ascospores *Physcia*-type, 21–28 × 10–16 µm **R. subcrustacea**
- 27: Ascospores *Physcia*-type transitioning to *Milvina*-type, 15–23 × 7–13 µm **R. cacaotina**

28	Ascospores <i>Tunicata</i> -type (double-walled).....	29
28:	Ascospores <i>Teichophila</i> - or <i>Pachysporaria</i> -type	30
29	Internal wall-thickenings <i>Physcia</i> - to <i>Mischoblastia</i> -type; spore-wall striate	
 R. straitunicata	
29:	Internal wall-thickenings <i>Pachysporaria</i> - to <i>Milvina</i> -type; spore-wall microrugulate	
 R. confragosula	
30	Ascospores <i>Pachysporaria</i> -type, 17–27 μm long	R. ramboldii
30:	Ascospores <i>Pachysporaria</i> - transitioning to <i>Milvina</i> -type, or <i>Mischoblastia</i> - transitioning to <i>Pachysporaria</i> - or <i>Physcia</i> -type	31
31	Ascospores <i>Pachysporaria</i> -type transitioning to <i>Milvina</i> -type, 13–21 \times 7–12 μm	
 R. williamsii	
31:	Ascospores <i>Mischoblastia</i> -type transitioning to <i>Pachysporaria</i> - or <i>Physcia</i> -type.....	32
32	Ascospores 20–32 \times 10–18 μm	R. teichophiloides
32:	Ascospores 16–23 \times 9–13 μm	R. cana

Acknowledgements

I thank Dr Helmut Mayrhofer and Dr Walter Obermayer (GZU), and Dr Gintaras Kantvilas (HO) for the loan of critical collections, and Dr Klaus Kalb (Neumarkt) for assistance with thin-layer chromatography.

References

- Elix, JA (2011): *Australian Physciaceae (Lichenised Ascomycota)*. Australian Biological Resources Study, Canberra. Version 18 October 2011. <http://www.anbg.gov.au/abrs/lichenlist/PHYSICIACEAE.html>
- Elix, JA; Giralt, M (2015): Two new species of *Rinodina* (Physciaceae, Ascomycota) from Fiji and Australia. *Australasian Lichenology* **77**, 32–35.
- Elix, JA; Kantvilas, G; McCarthy, PM (2019): Two new species of *Rinodina* (Physciaceae, Ascomycota) from southern Australia. *Australasian Lichenology* **84**, 10–15.
- Grube, U; Mayrhofer, H; Elix, JA (2019): A further new species of *Rinodina* (Physciaceae, Ascomycota) from eastern Australia. *Australasian Lichenology* **85**, 16–19.
- Kaschik, M (2006): Taxonomic studies on saxicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) in the Southern Hemisphere with emphasis in Australia and New Zealand. *Bibliotheca Lichenologica* **93**, 1–162.
- Matzer, M; Mayrhofer, H (1994): The saxicolous *Rinodina teichophila* and three closely related species from the Southern Hemisphere (Physciaceae, lichenized Ascomycetes). *Acta Botanica Fennica* **150**, 109–120.
- Matzer, M; Mayrhofer, H (1996): Saxicolous species of the genus *Rinodina* (lichenized Ascomycetes, Physciaceae) in southern Africa. *Bothalia* **26**, 11–30.
- Matzer, M; Mayrhofer, H; Elix, JA (1998): *Rinodina peloleuca* (Physciaceae), a maritime lichen with a distinctive austral distribution. *New Zealand Journal of Botany* **36**, 175–188.
- Mayrhofer, H (1984): The saxicolous species of *Dimelaena*, *Rinodina* and *Rinodinella* in Australia. *Beihfte zur Nova Hedwigia* **79**, 511–536.
- Mayrhofer, H; Elix, JA (2018): A new species of *Rinodina* (Physciaceae, Ascomycota) from eastern Australia. *Australasian Lichenology* **83**, 22–25.
- Mayrhofer, H; Scheidegger, C; Sheard, JW (1990): *Rinodina lecanorina* and *R. luridata*, two closely related species on calciferous rocks. *Bibliotheca Lichenologica* **38**, 335–356.
- Sheard, JW (2010): *The Lichen Genus Rinodina (Ach.) Gray (Lecanoromycetidae, Physciaceae) in North America, North of Mexico*. NRC Research Press, Ottawa.
- Trinkaus, U; Mayrhofer, H; Matzer, M (1999): *Rinodina gennarii* (Physciaceae), a widespread species in temperate regions of the Southern Hemisphere. *Australasian Lichenology* **45**, 15–21.



Figure 1. *R. herteliana* (Elix 20688 in CANB). Scale bar = 1 mm.



Figure 2. Ascospore ontogeny of *R. herteliana*. Scale bar = 10 μm .