

Two new lichenicolous species of *Sclerococcum* (asexual Ascomycetes) growing on Graphidaceae

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Abstract. The new species *Sclerococcum aptrootii*, collected on *Fissurina* in Puerto Rico, and *S. sipmanii*, collected on *Anomomorpha* in Malaysia, are described and illustrated. Both are macroscopically rather similar and have dark brown, 0(–1)-septate conidia. *Sclerococcum aptrootii* is mainly characterized by smooth conidia not reacting in K, whilst *S. sipmanii* has conidia with a distinct ornamentation that become greenish olivaceous in K. *Sclerococcum simplex*, another species with 1-septate conidia is compared with the new species and illustrated. A key to all known lichenicolous species of *Sclerococcum* is given.

1. Introduction

The asexual genus *Sclerococcum* Fr. was initially described for the single species *S. sphaerale* (Ach.) Fr. (Hawksworth 1975), a rather common hyphomycete forming convex, blackish sporodochia with dark brown, multi-cellular conidia on saxicolous *Pertusaria corallina*. A second species with aseptate conidia, *S. simplex* D. Hawksworth, was later described from corticolous *Pertusaria* species (Hawksworth 1979). Eventually, more and more species were added to the genus (e.g., Etayo & Calatayud 1998), which became more and more heterogeneous. Diederich et al. (2013) presented a first phylogenetic study of *Sclerococcum* and showed that the type species is closely related to *Dactylospora* (Eurotiomycetes), whilst *S. parmeliae* Etayo & Diederich, a species with catenate conidia, belongs to Chaetothyriales. Consequently, *S. parmeliae*, together with four other species (one described as new) were included in the asexual genus *Cladophialophora* Borelli by Diederich et al. (2013). A further species, *Sclerococcum griseosporodochium* Etayo, was described as possibly lichenicolous over saxicolous *Opegrapha* (Etayo 1995), but is now regarded as a lichenized, non-lichenicolous species associated with a *Trentepohlia* photobiont (Smith 2009), and is almost surely not related with *Sclerococcum*.

In this paper, we describe two new lichenicolous species of *Sclerococcum*, both collected on Graphidaceae hosts. Unfortunately, each of them is known only from the type specimen, collected in 1989. As no additional specimens became available, we conclude that both must be very rare and hope that the description of them will encourage lichenologists working in tropical countries to look for more material.

2. Material and Methods

The studied specimens are kept in B, BR and in the private collection of the author. Dry herbarium specimens were examined and measured under a binocular microscope Leica MZ 7.5 (magnification up to $\times 50$), and photographed using a Canon 40D camera with a Nikon BD Plan 10 microscope objective, StackShot (Cognisys) and Helicon Focus (HeliconSoft) for increasing the depth of field. Hand-made sections of conidiomata were studied in water, 5% KOH and Phloxine B. Microscopic photographs were prepared using a Leica DMLB microscope, a Leica EC3 camera and Helicon Focus. Conidial measurements are indicated as (min.–) \bar{X} – σ_x – \bar{X} + σ_x (–max.), followed by the number of measurements (n); the length/breadth ratio of conidia is indicated as Q and given in the same way. Chemical reactions were tested using 5% KOH (K).

3. Results

Sclerococcum aptrootii Diederich sp. nov.
(Figs 1–2)

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Similar to *Sclerococcum simplex*, but conidiomata smaller, 50–100 µm diam., conidia slightly smaller and darker, when 1-septate easily breaking in part-conidia, and by the different host-selection, *Fissurina dumastii*.

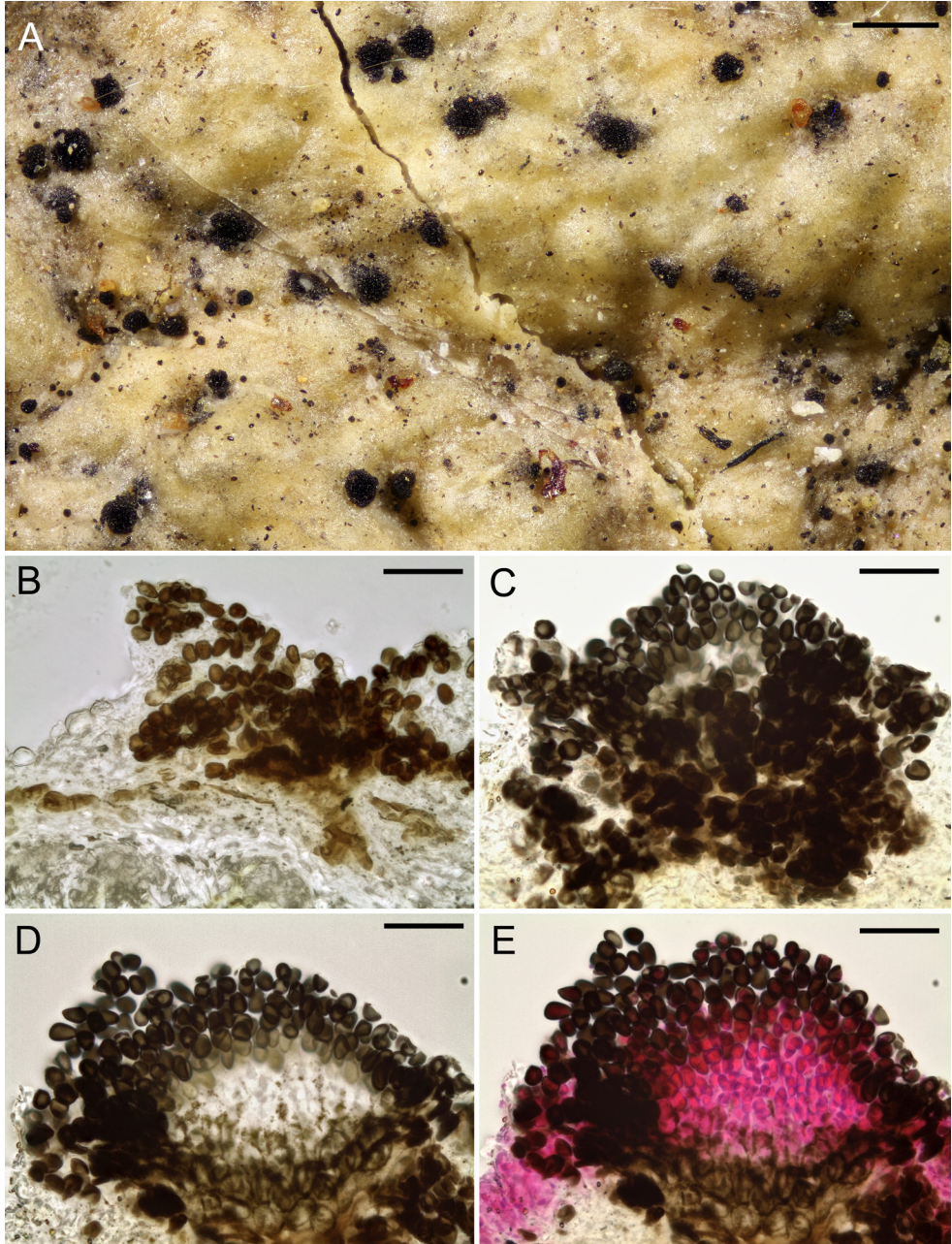


Fig. 1. *Sclerococcum aptrootii* (holotype). A, Minuscule conidiomata over thallus of *Fissurina dumastii*. B, Section through young conidioma, showing immersed vegetative hyphae (in water). C–E, Section through mature conidiomata (C–D in KOH, E in Phloxine B after K pretreatment). Scale bars: A = 200 µm; B–E = 20 µm.

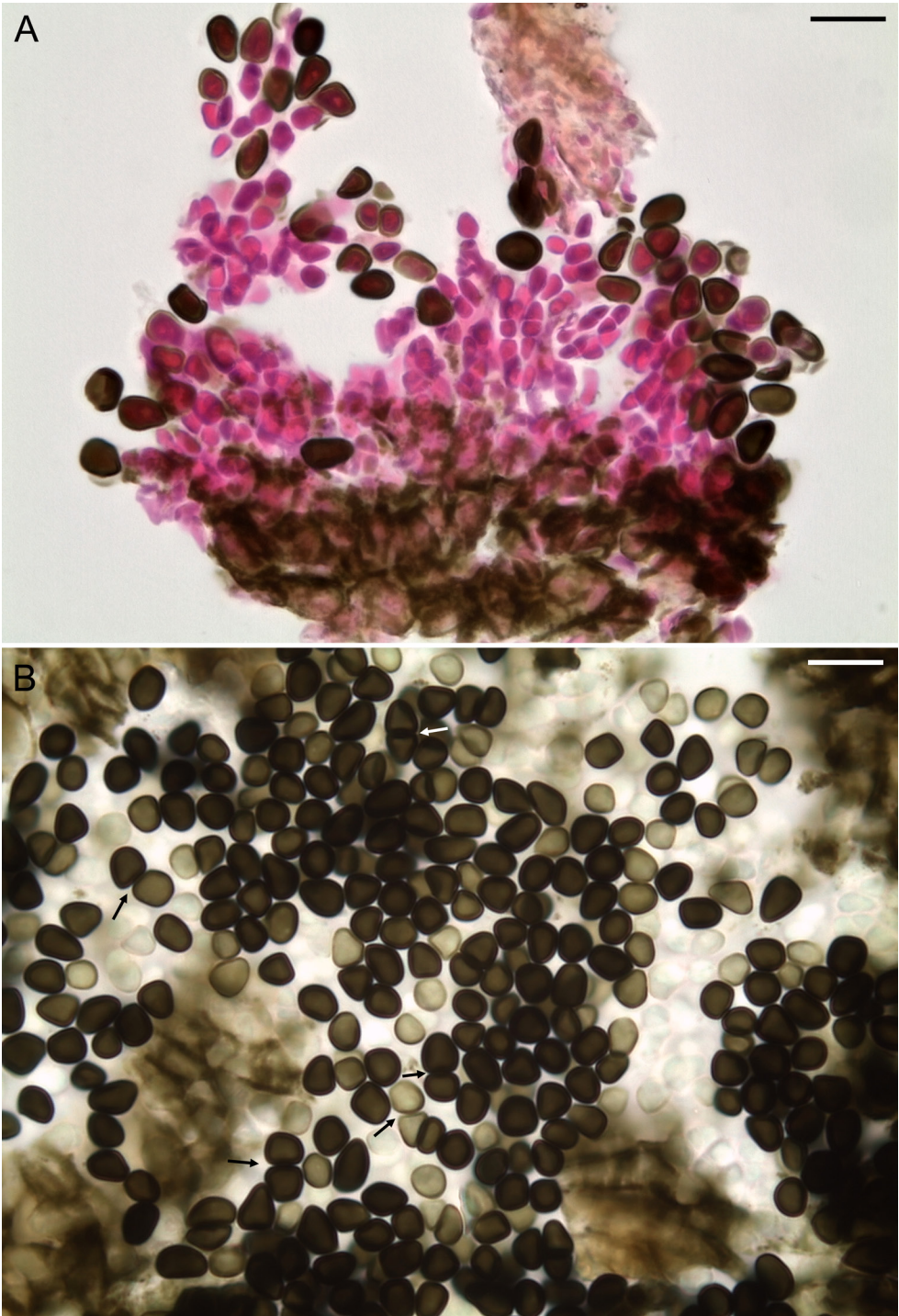


Fig. 2. *Sclerococcum aptrootii* (holotype). A, Section through conidioma, with conidiophores separated through pressure on cover glass (in Phloxine B after K pre-treatment). B, Conidia (in K); arrows point to septa of 1-septate conidia. Scale bars: 10 μ m.

Typus: USA, Puerto Rico, Distr. Mayagüez, Reserva forestal Maricao, N of Sabana Grande, along road 120, km 16-17, 18°09' N, 66°59' W, 800 m, on tree in low mountain forest on dry serpentine, on *Fissurina dumastii*, 21–31 May 1989, A. & M. Aptroot 25001 (BR–holotype; herb. Diederich–isotype).

Colonies lichenicolous on *Fissurina dumastii*, forming initially immersed, later erumpent minuscule convex sporodochia, black, rounded, 50–100 µm diam., not confluent. Vegetative hyphae hyaline to brown, immersed in the host thallus, mainly 2–4 µm thick. Conidiophores aggregated into dense sporodochia, not or sparsely branched, hyaline or pale brown, mainly 2–3 µm thick. Conidiogenous cells monoblastic or rarely polyblastic, terminal, integrated, hyaline or pale brown, not very distinct. Conidia produced in short basipetal chains, separating easily, dry, acrogenous, ellipsoid or angular, medium to dark brown, mainly non-septate, (4.5–)5.0–6.3(–7.2) × (4.0–)4.1–5.0(–5.7) µm, Q = (1.0–)1.1–1.4(–1.8) (n = 40), with a rather thick, smooth wall, 0.5 µm thick, rarely 2-celled, but then cells separating easily, the resulting part-conidia often more or less triangular, the lower cell often paler, of the same size as aseptate conidia. All parts K– (becoming slightly darker).

Distribution and hosts. Known only from the type locality in Puerto Rico on the thallus of *Fissurina dumastii*, which is not visibly damaged.

Observations. The new species is similar to *Sclerococcum simplex* D. Hawksw., the only hitherto known *Sclerococcum* species with smooth-walled, mainly non-septate conidia. That species differs from *S. aptrootii* by the larger, often confluent conidiomata, (50–)100–300 µm diam., slightly larger and distinctly paler conidia, (3.5–)4–7(–8) µm, the presence of 1-septate conidia not separating in part-conidia under slight pressure (Fig. 3), and by a different host selection, being confined to corticolous *Pertusaria* species in Austria, the British Isles, the western Pyrenees (France and Spain), and the USA (Cole & Hawksworth 2001; Etayo & Calatayud 1998; Hawksworth 1979). The type specimen of *S. aptrootii* is further inhabited by a second lichenicolous fungus, *Etayoa tryphethelii* (Flakus & Kukwa) Diederich & Ertz, readily distinguished by the

entirely superficial conidiomata and the very distinct, multicellular conidia.

Additional specimen examined: Same locality as type, 24 May 1989, H. Sipman 25989 (B 78529).

Sclerococcum sipmanii Diederich sp. nov. (Fig. 4)

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Conidiomata black, convex, 100–200(–250) µm diam., conidia aseptate, brown, mainly 6.9–9.2 × 4.9–6.2 µm, more rarely 1-septate, 10.8–13.5 × 5.1–6.5 µm, surface becoming mosaic-like and rough after irregular splitting of wall, all parts K+ greenish olivaceous.

Typus: Malaysia, State of Sabah, Distr. Kota Belud, Kinabalu Park, S-slope of Mount Kinabalu, along Summit Trail, 6°05' N, 116°35' E, 2800 m, stunted mossy forest on mountain ridge ± halfway between Villosa shelter and Carson's Camp, on *Anomomorpha* cf. *roseola*, 12 May 1989, H. Sipman 31294a & B. Tan (B–holotype; herb. Diederich–isotype).

Colonies lichenicolous on *Anomomorpha* cf. *roseola*, forming initially partly immersed, later erumpent convex sporodochia, black, rounded, 100–200(–250) µm diam., not or occasionally confluent. Vegetative hyphae hyaline to pale brown, immersed in the host thallus, often indistinct. Conidiophores aggregated into dense sporodochia, not or sparsely branched, pale to medium brown, mainly 3–5 µm thick, separating with difficulty. Conidiogenous cells monoblastic or rarely polyblastic, terminal, integrated, pale to medium brown, not very distinct. Conidia produced in short basipetal chains, separating easily, dry, acrogenous, short to elongate ellipsoid, medium to dark brown, mainly non-septate, (5.2–)6.9–9.2(–10.0) × (4.0–)4.9–6.2(–7.0) µm, Q = (1.0–)1.2–1.7(–2.2) (n = 40), with a thick wall, 0.5–0.8 µm thick, outer wall layer often splitting irregularly when mature, giving the conidial surface a mosaic-like, often strongly roughened aspect, rarely 1-septate, cells not separating, septum rather dark, (9.7–)10.8–13.5(–14.5) × (4.5–)5.1–6.5(–7.3) µm, Q = (1.7–)1.8–2.4(–3.1) (n = 20). All parts K+ greenish olivaceous.

Distribution and hosts. Known only from the type locality on Mount Kinabalu in Sabah, Malaysia, on the thallus of *Anomomorpha* cf. *roseola*, not visibly damaging the host.

Observations. The new species is distinguished from most known *Sclerococcum* species by the mainly aseptate conidia. *Sclerococcum aptrootii* and *S. simplex* readily differ by smooth-walled conidia. *Sclerococcum verrucisporum* Alstrup is distinguished by much larger conidiomata, reaching 600 µm in diam., brownish green conidiophores, subspherical, never septate conidia, 5–8 × 4.5–6 µm, with a verrucose wall, and a different host, *Bellemerea diamarta* (Alstrup 1993).

Key to the known lichenicolous species of *Sclerococcum*

N.B.: *Sclerococcum acarosporae* S. Y. Kondr., described from *Acarospora* cf. *laqueata* in Israel, is not included here, owing to deviating morphological characters. The conspicuous vegetative hyphae described and illustrated by the authors strongly remind one of species of *Lichenostigma* subgen. *Lichenogramma* (Calatayud et al. 2002, Navarro-Rosinés & Hafellner 1996). Conidiomata are described as “dense tufted convex sporodochia 46–69 µm diam., sometimes aggregated in larger groups to 120 µm diam., or in line-like parallel aggregations to 230–360 µm across” (Kondratyuk & Zelenko 2002).

- 1. Conidia 1(–2)-celled 2
- 1. Conidia 2- to multi-celled 5
- 2. Conidia smooth-walled 3
- 2. Conidial wall ornamented..... 4
- 3. Conidiomata 50–100 µm diam., not confluent; conidia medium to dark brown, mostly 5–6.5 × 4–5 µm, when 1-septate, cells easily separating in part-conidia; on *Fissurina*..... ***S. aptrootii* Diederich**
- 3. Conidiomata (50–)100–300 µm diam., often confluent; conidia paler, 4–7 µm diam., when 1-septate, not separating in part-conidia; on corticolous *Pertusaria* (Hawksworth 1979) ***S. simplex* D. Hawksw.**
- 4. Conidiomata 100–200(–250) µm; conidia aseptate, mostly 7–9 × 5–6 µm, or 1-septate, 11–13.5 × 5–6.5 µm, outer wall splitting at maturity, giving a mosaic-like ornamentation; on *Anomomorpha*..... ***S. sipmanii* Diederich**
- 4. Conidiomata up to 600 µm diam.; conidia aseptate, 5–8 × 4.5–6 µm, with a verrucose wall; on *Bellemerea diamarta* (Alstrup 1993) ***S. verrucisporum* Alstrup**

- 5 Conidia smooth-walled 6
- 5 Conidial wall ornamented..... 9
- 6 Conidia mainly 2-celled, occasionally aseptate or submuriform, wall occasionally fissured; conidiomata 200–300 µm; on *Lecanora rupicola* (Hafellner 1996)..***S. montagnei* Hafellner**
- 6 Conidia mostly more than 2-celled..... 7
- 7 Conidia 2–14(–20)-celled, with irregular, well-delimited darker regions due to an unevenly thickened cell wall; conidiomata 60–180 µm diam.; on *Parmelina* (Boqueras & Diederich 1993).....***S. serusiauxii* Boqueras & Diederich**
- 7 Conidia 2–6-celled, cells ± evenly thickened; conidiomata 170–500 µm diam..... 8
- 8 Conidiomata 170–350 µm diam., dark brown to black; conidia in surface view (×40) hardly visible, slightly shiny, often arranged in groups of 30–70 µm diam.; conidial cells (4–)6–10 µm diam.; on *Pertusaria coralina*, rarely other saxicolous *Pertusaria* spp. (Hawksworth 1975).....***S. sphaerale* (Ach.) Fr.**
- 8 Conidiomata 225–500 µm diam., dark reddish brown; conidia in surface view granular, easily visible, matt, not arranged in groups; conidial cells 3–6 µm diam.; on *Varicellaria hemisphaerica* (Diederich 1990) ***S. epiphytorum* Diederich**
- 9 Conidia 10–15 × 7–13 µm, greenish brown, wall verruculose; conidiomata 100–400 µm; on *Buellia aethalea* (Diederich & Scholz 1995).....***S. leuckertii* Diederich & Scholz**
- 9 Conidia not greenish..... 10
- 10 Conidiomata 50–150 µm diam.; conidia dark brown, 2–4-celled, 11–21 × 8–15 µm, wall verrucose-fissured; sporodochia 50–150 µm, finally concave; on *Tephromela atra* (Etayo & Calatayud 1998) ***S. tephromelarum* Etayo & Calatayud**
- 10 Conidia at least 200 µm diam.; conidia with an ornamentation of polygonal areoles 11
- 11 Conidia blue-grey when young, later dark brown, 2–5-celled, 8–12.5 × 6.5–8 µm, irregularly covered by dispersed, thick, almost squamulose areoles; conidiomata 250–300 µm diam.; on *Placopsis gelida* (Berger 2000) ***S. gelidarium* Etayo & F. Berger**
- 11 Conidia brown to black, 2–3-celled, 10–12 × 5.5–8 µm, covered by thinner areoles; conidiomata 200–400 µm diam.; on cf. *Xylographa* (Etayo & Sancho 2008).....***S. areolatum* Etayo**

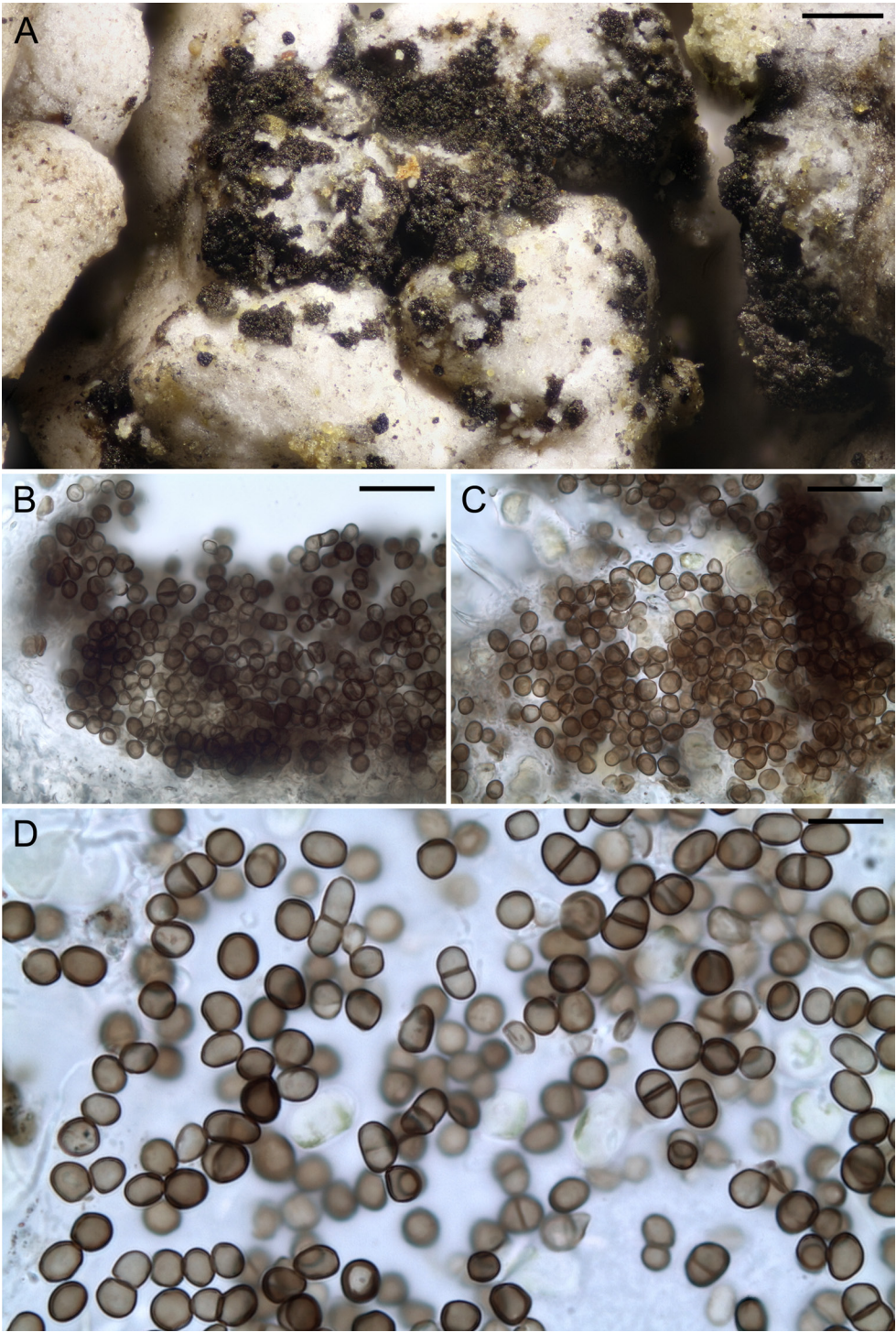


Fig. 3. *Sclerococcum simplex* (Spain, Navarra, Diederich 9623). A, Confluent conidiomata over thallus of *Pertusaria*. B-C, Section through conidiomata (in water). D, Conidia (in K). Scale bars: A = 200 μ m; B-C = 20 μ m; D = 10 μ m.

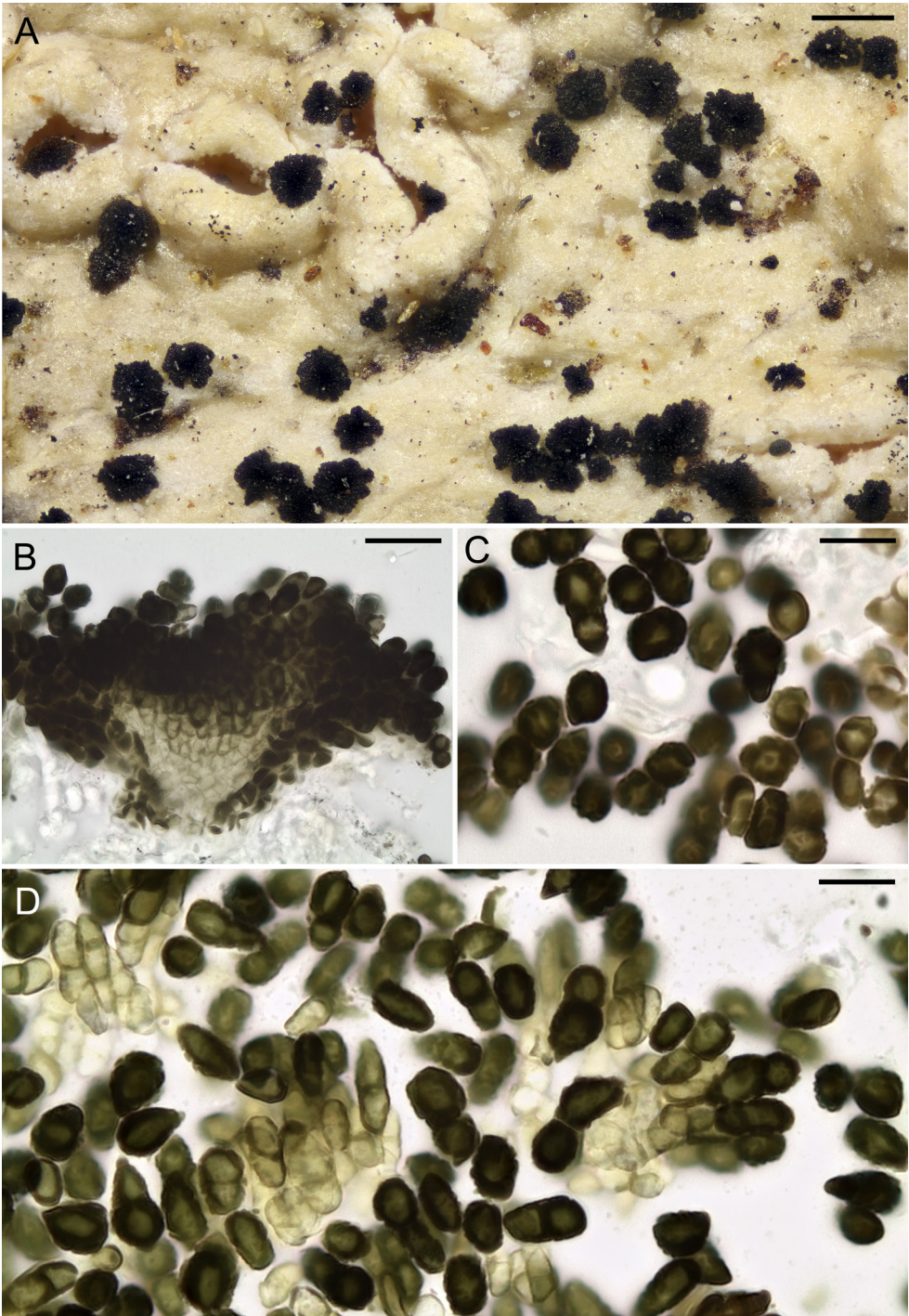


Fig. 4. *Sclerococcum sipmanii* (holotype). A, Conidiomata over thallus of *Anomomorpha* cf. *roseola*. B, Section through conidioma. C, Conidia. D, Conidiogenous cells and conidia (B–D, in K). Scale bars: A = 200 μ m; B–C = 20 μ m; D = 10 μ m.

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