TWO NEW SPECIES OF LICHENICOLOUS FUNGUS
SCLEROCOCUM (DACTYLOSPORACEAE, SCLEROCOCCALES)
FROM INDIA

Y. Joshi

Lab. no. 14, Department of Botany, University of Rajasthan, Jaipur 302004, Rajasthan, India
E-mail: dryogeshcalo@gmail.com

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Two new species of Sclerococcum, viz. S. dendriscostictae and S. physciae, colonising members of Dendriscosticta, Physcia and Sticta, are described from Uttarakhand and Andhra Pradesh states of India, respectively. S. dendriscostictae colonising the host thallus as well as apothecial disc of Dendriscosticta and Sticta species is generally characterised by its small sized (0.1–0.4 mm) black apothecia, hyaline hymenium, paraphyses without dark apical caps, asci 8-spored, ascospores ellipsoid, hyaline at immature stage and brown at maturity, 1-septate, smooth walled, 9–10–11×(–12) × (3–)3.8–5.6–6.1(–7) µm, while S. physciae colonising thallus of Physcia sp. is characterised by black, rounded to irregular sporodochia (40–100 µm diam.) having ellipsoid or angular, medium to dark brown, mostly simple, rarely 1-septate conidia [(5–)7.5–10–11.7(–14) × (4–)4.7–5.8–6.9(–7) µm]. A key to known Indian taxa is also being provided.

Key words: Dactylospora, lichens, Sclerococcaceae, taxonomy

INTRODUCTION

The genus Sclerococcum Fr. belonging to family Dactylosporaceae Körb. is the fourth species rich genus of lichenicolous fungi after Arthonia (140 species), Stigmidium (94 species) and Opegrapha (72 species), and is represented by 64 species of lichenicolous fungi throughout the world (Diederich et al. 2018). The members of this genus are saprobic on bark/wood, liverworts or are commensalistic fungi growing on lichens (Hafellner 2004, Hawksworth et al. 1995, Jaklitsch et al. 2016, Pang et al. 2014), and are characterised by superficial to stalked blackish apothecia, excipulum composed of textura angularis to globulosa cells, hymenium of thick gelatinous matrix, paraphyses sparingly branched with apices slightly swollen and pigmented, asci cylindrical to clavate, amyloid with I– tholus covered by an I+ blue external gelatinous cap, ascospores subglobose to ellipsoid with one to several transverse septa, mostly 8 per ascus (Bellemère and Hafellner 1982, Döbbeler and Buck 2017, Hafellner 1979), conidiomata blackish sporodochial-stromatic, conidiogenesis thallic, probably meristem thallic (meristem arthric) (Kiffer and Morelet 2000, Seifert et al. 2011), conidia dark brown, uni- to multi-cellular (Diederich et al. 2013, Miadlikowska et al. 2014). Recently the genus has been circumscribed
based on evidence from molecular phylogenetics (Diederich et al. 2013, 2018, Pino-Bodas et al. 2017), and all the previously described Dactylospora species are now synonymised under it and belong to family Dactylosphoraceae in the recently described order Sclerococcales.

Till date six species of the genus (excluding S. sphaerale (Ach.) Fr.) are noticed in Indian flora colonising various lichens, i.e. S. deminutum (Th. Fr.) Ertz et Diederich, S. homoclinellum (Nyl.) Ertz et Diederich, S. protothallinum (Anzi) Ertz et Diederich, S. rimulicola (Müll. Arg.) Ertz et Diederich, S. saxatile (Schaer.) Ertz et Diederich and S. simplex D. Hawksw. (Joshi 2018, Joshi et al. 2016, 2018).

During the course of studies on lichenicolous fungi of India, the author found some interesting Sclerococcum species colonising Dendriscosticta, Physcia and Sticta species, which resulted in the discovery of two new species, Sclerococcum dendriscostictae Y. Joshi and S. physciae Y. Joshi, thus raising number of species to 8 from India and 66 from the world.

MATERIALS AND METHODS

The studied specimens are deposited in the herbaria of CSIR-National Botanical Research Institute (LWG) including the personal herbarium of D. D. Awasthi (AWAS) and Lucknow University (LWU). The materials were examined and measured under stereozoom dissecting microscope (Olympus SZ61). Hand-made sections were made for studying the anatomy of fruiting bodies and examined under a compound microscope (Olympus BX53) equipped with Olympus differential interference contrast optics. Microscopical examination was done in water, 10% KOH (K), lactophenol cotton blue (LCB), Lugol’s iodine, directly (I) or after a KOH pre-treatment (K/I). Ascospores and conidia measurements are presented as: arithmetic mean – standard deviation, arithmetic mean, and arithmetic mean + standard deviation, flanked by the minimal and maximal measurements in parentheses, and the length/breadth ratio of conidia is indicated as Q and presented in the same way, followed by the number of measurements (n). Values in italics (e.g., –11.6–) are arithmetic means.

RESULTS AND DISCUSSION

Sclerococcum dendriscostictae Y. Joshi, spec. nova
(Fig. 1a–d)

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Similar to Sclerococcum homoclinellum (Nyl.) Ertz et Diederich (on species of Lecanora and Tephromela) in having similar ascospore size but differs in lacking paraphyses with dark apical caps and different host.
Type: India. NW Himalaya (now Uttarakhand), Tehri Garhwal, below Jamunotri, alt. 2,743 m, on Sticta nylanderiana (now Dendriscosticta platyphylla) colonising bark of Quercus, 21 June 1951, D. D. Awasthi 901 (holotype: LWG-AWAS 12950; isotype: RUBL).

Lichenicolous fungus growing on the thallus and apothecial disc of Dendriscosticta and Sticta species (Fig. 1a–b). Ascomata apothecia, rounded, 0.1–0.3(–0.4) mm in diameter; numerous, sessile to rarely constricted at base, arising singly, disc flat, rough, black; margin distinct, raised above the level of disc, concolorous (Fig. 1a–b). Lateral exciple 30–40 µm wide, composed of large, thin-walled, cells of textura angularis, outer cell layer is dark brown, inner cells are hyaline to pale brown K–, N– (Fig. 1c). Lower exciple (hypotheicum) (25–)30–40(–60) µm wide, medium reddish brown, composed of thick walled isodiametric cells, K–, N– (Fig. 1c). Hymenium hyaline, (25–)35–50(–75) µm high (Fig. 1c). Epihymenium brown, (6–)10–15(–18) µm, K–, N– (Fig. 1c). Paraphyses filamentous, septate, branched to anastomosed, 1–1.5 µm thick, slightly swollen at the tips. Asci with a K/I+ blue outer layer, 8-spored, unitunicate, cylindrical to subclavate, rounded at the apex, sessile, (28–32.7–38.4–44(–50) × (9–)9.7–11.6–13.5(–15) µm (n = 40) (Fig. 1d). Ascospores ellipsoid, hyaline at immature stage and brown at maturity, 1-septate, smooth walled, 9–10–11(–12) × (3–)3.8–5–6.1(–7) µm (n = 40), perispore present, 0.5 µm. Conidiomata not observed.

Host: On thallus and apothecial disc of foliose cyanolichens Dendriscosticta and Sticta.

Etymology: The epithet refers to the host lichen genera Dendriscosticta and Sticta on which the fungus is colonising.

Ecology and distribution: Sclerococcum dendriscostictae is known from two collections in the Himalaya, found growing on the thallus and apothecial disc of different Dendriscosticta and Sticta species colonising tree bark and rocks. Since no pathogenicity was observed, hence it is a commensalistic species.

Taxonomic remarks: The new taxon is generally characterised by its small sized (0.1–0.4 mm) black apothecia, hyaline hymenium, epihymenium brown K–, N–, paraphyses without dark apical caps, asci 8-spored, ascospores ellipsoid, hyaline at immature stage and brown at maturity, 1-septate, smooth walled, 9–10–11(–12) × (3–)3.8–5–6.1(–7) µm and colonising the host thallus, as well as rarely apothecial disc of Dendriscosticta and Sticta species.

The following eleven species of Sclerococcum having 8-spored asci and 1-septate ascospores of somewhat similar size differs from the new taxon in various ways: S. acarosporicola Ertz et Diederich differs in having paraphyses with dark apical caps, narrower ascospores, 8–11 × 3.5–5 µm and used to colonise Acarospora species; S. aeruginosum (Holien et Ihlen) Ertz et Diederich, which used to infect various crustose lichens and also bark and wood differs.
Fig. 1. *Sclerococcum dendriscostictae* (holotype): a = thallus of *Dendriscosticta platyphylla* infected by *Sclerococcum* (scale bar: 1 mm); b = magnified view of infected part (scale bar: 0.1 mm); c = section through apothecium (scale bar: 50 µm); d = ascus with ascospores 60× (scale bar: 10 µm)
by the presence of violet blue, K+ aeruginose patches in apothecial sections; *S. amygdalae* (Triebel) Ertz et Diederich has paraphyses with dark apical caps and colonises thallus of *Amygdalaria* species; *S. anziae* (Zhurb., Ezhkin, Skirina et Y. Ohmura) Ertz et Diederich colonising thallus and apothecial disc of various *Anzia* species has K+ brown to greyish brown epihymenium and somewhat bigger asci [(42–)44–56–(60) µm]; *S. athallinum* (Müll. Arg.) Ertz et Diederich differs in having K+ purple epihymenium, somewhat longer ascospores (9–14.5 µm) and different host (*Baeomyces rufus* (Huds.) Rebent.); *S. australae* (Triebel et Hertel) Ertz et Diederich infecting *Lecidea, Paraporpidia, Poeltiaria, Poeltidea, Porpidia, Rimularia* and *Tremolecia* spp., has paraphyses with dark apical cap and somewhat longer and narrower ascospores (7.5–13.5 × 4–6 µm); *S. homoclinellum* has paraphyses with dark apical caps and colonises *Lecanora* and *Tephromela* spp.; *S. protothallinum* differs in having a hyaline hymenium and paraphyses with dark apical caps; *S. saxatile* differs in having initially immersed apothecia, paraphyses with dark apical caps, longer ascospores, 9–15 × 4.5–7.5 µm and host preference (*Ochrolechia* and *Pertusaria*); *S. tegularum* (Arnold) Ertz et Diederich, which colonises Caloplaca species differs in having immersed apothecia and paraphyses with dark apical caps (Zhurbenko et al. 2017).

Additional specimens examined: India, Uttarakhand, Almora district (now Bageshwar), en route to Pindari Glacier, Dhakuri ridge, alt. 2,895 m, on *Sticta nylanderiana* (now *Dendriscosticta platyphylla*) colonising tree bark, 19 May 1950, D. D. Awasthi & A. M. Awasthi 651 (LWG); ibid., on *Sticta henryana* colonising tree bark, D. D. Awasthi & A. M. Awasthi 651 (LWG); ibid., alt. 2,850 m, s.d., on *Sticta wrightii* (now *Dendriscosticta wrightii*) colonising rock, D. D. Awasthi & A. M. Awasthi 651 (LWG).

### Sclerococcum physciae Y. Joshi, spec. nova
(Fig. 2a–b)

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*Differs from Sclerococcum aptrootii Diederich by bigger conidia [(5–)7.5–10–11.7(–14) × (4–)4.7–5.8–6.9(–7) µm vs 5–6.5 × 4–5 µm] and a different host selection (Physcia vs Fissurina dumastii Fée).*

Colonies lichenicolous on *Physcia sp.*, forming erumpent minuscule convex sporodochia, black, rounded to irregular, 40–100 µm diam., solitary to confluent. Vegetative hyphae hyaline to brown, immersed in the host thallus, indistinct. Conidiophores aggregated into dense sporodochia, not or sparsely branched, hyaline or pale brown. Conidiogenesis meristem thallic. Conidiogenous cells terminal, integrated, hyaline or pale brown, not very distinct. Conidia produced in short basipetal chains, separating easily, dry, acrogenous, subspherical, ellipsoid or angular, medium to dark brown, mostly simple, rarely 1-septate, but then cells separating easily, the resulting part-conidia of-

*Fig. 2. Sclerococcum physciae*: a = simple to 1-septate conidia 60× (in water); b = in KOH (arrows indicating septation) (scale bar: 10 µm)
SCLEROCOCCUM DENDRISCOSTICTAE AND S. PHYSCIAE NEW TO SCIENCE

SCLEROCOCCUM DENDRISCOSTICTAE AND S. PHYSCIAE NEW TO SCIENCE

ten more or less triangular (Fig. 2a–b), septum 1.5–3 µm thick, dark brown, often with a distinct blackish lamella, (5–)7.5–10–11.7–(14) × (4–)4.7–5.8–6.9–(7) µm, Q = (0.8–)1.1–1.4–1.7–(2) (n = 40), with a rather thick, smooth wall, (0.5–)0.7–1–1.3–(1.5) µm thick. All parts K– (becoming slightly darker).

Host: On thallus of foliose phyclichen Physcia.

Etymology: The epithet is derived from the name of the host.

Ecology and distribution: The new taxon is the first species of lichenicolous fungus from the state of Andhra Pradesh and is known only from the type locality collected in 1986, inhabiting corticolous species of lichen genus Physcia. Since no pathogenicity was observed, it is supposedly a commensalistic species.

Taxonomic remarks: In having somewhat similar conidiomata size (up to 100 µm) and simple to 1-septate conidia which separates easily apart, the new taxon resembles Sclerococcus aptrootii, which differs in having smaller conidia [5–6.5 × 4–5 µm vs (5–)7.5–10–11.7–(14) × (4–)4.7–5.8–6.9–(7) µm] and a different host (Fissurina dumastii vs Physcia). Sclerococcus phaeophysciae Diedrich et van den Boom, another species of the genus, which used to colonise members of lichen family Physciaceae, differs in having bigger conidiomata (200–600 µm diam.), bigger conidia [(9.7–)11.1–14.6–(17) × (8–)9.1–10.9–(12) µm] and a different host selection (Phaeophyscia orbicularis (Neck.) Moberg).

The new taxon has smaller conidiomata (40–100 µm diam.), smaller conidia [(5–)7.5–10–11.7–(14) × (4–)4.7–5.8–6.9–(7) µm] and a different host selection (Physcia). Sclerococcus simplex differs in having bigger conidiomata (50–100–300 µm diam., smaller conidia (4–7 µm diam.) which do not get separated, and corticolous Ochrolechia and Pertusaria species as hosts. Sclerococcus montagnei Hafellner, differs in having mainly 1-septate often irregularly catenate conidia, bigger conidiomata (200–300 µm diam.) and a different host, viz. Leccana corallina (L.) Zahlbr. (Hafellner 1996).

Key to the species of Sclerococcus in India

1a Fructifications are sporodochial conidiomata

1b Fructifications are apothecioid ascomata

2a Conidiomata 40–100 µm diam., conidia [(5–)7.5–10–11.7–(14) × (4–)4.7–5.8–6.9–(7) µm], when 1-septate, then cells separating easily, the resulting part-conidia often more or less triangular; on thallus of Physcia sp.

2b Conidiomata (50–)100–300 µm diam., conidia 4–7 µm diam., when 1-septate, not separating in part-conidia; on thallus, soredia and apothecial disc of Leprula albescens, L. amara, L. multipuncta, Ochrolechia subpallescens, O. yasudae var. corallina, Pertusaria coronata, P. leioplaca, P. melastomella S. simplex

S. physciae

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3a Ascospores always 1-septate
3b Ascospores 3-7 septate, 14–22 × 5–7 µm; on thallus of Parmotrema kamatii
4a On thalli and ascomata of foliose cyanobacterial lichens
4b On thalli and/or ascomata of crustose lichens
5a Ascospores 9–15 × 4.5–7.5 µm; on thallus of Parmeliella tryptophylla
5b Ascospores 9–10–11–(12) × (3–)3.8–5–6.1(–7) µm; on thallus and apothecial disc of Dendriscosticta platyphylla, D. wrightii and Sticta henryana
6a Hypothecium hyaline to brown or olivaceous green
6b Hypothecium dark brown to almost black, apothecia slightly stalked; on thallus of Lecanora flavidofusca
7a Ascospores > 5–6 µm broad; on thallus and apothecial disc of Pertusaria indica, P. leioplaca, P. pertusa, P. quassiae
7b Ascospores < 5–6 µm broad; on thallus of Lecanora fimbriatula, L. impudens, Protoparmeliopsis muralis

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