

Two species of *Carbacanthographis* from India

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Abstract: Two species of the lichen genus *Carbacanthographis*, namely *C. marcescens* and a new species, *C. sorediata*, are reported from India. The new species is characterized by a sorediate thallus, laterally carbonized exciple, submuriform ascospores, and salazinic and consalazinic acids in the thallus. A worldwide key to the species of *Carbacanthographis* is provided.

Key words: *Graphidaceae*, lichenized Ascomycota, taxonomy

Introduction

The lichen genus *Carbacanthographis* Staiger & Kalb was established by Staiger & Kalb (2002). It comprises species in the family *Graphidaceae* characterized by a convergent, carbonized exciple, labia covered with a distinct white pruinose layer in the upper part, warty periphysoids, and I– or weakly I+, muriform or trans-septate ascospores. So far the genus is known to include 17 species world-wide (Staiger 2002; Kalb 2004; Archer 2006, 2007; Lücking *et al.* 2009) and has been reported from the Neotropics, Africa, Australia, Singapore, Japan and the Solomon Islands. Vegetative propagules are generally rare in *Graphidaceae*, but in our recent studies in the family, we have discovered one sorediate species which belongs to the genus *Carbacanthographis*. This species is formally described in the present paper. A key to the species of *Carbacanthographis* so far known is also provided.

Materials and Methods

The study is based on herbarium specimens housed at the Ajrekar Mycological Herbarium (AMH). Sections of thalli and ascomata were mounted in water, 10% KOH (K), Lugol's solution (I), and lactophenol cotton-blue

(LPCB). All measurements were made on material mounted in water. Secondary products were identified by thin-layer chromatography using standard methods (Culberson & Kristinsson 1970; Culberson 1972; White & James 1985) with the solvent systems toluene-dioxane-acetic acid (180:45:5) and toluene-ethyl acetate-formic acid (139:83:8). The plates were examined under UV light (365 nm).

The Species

Carbacanthographis marcescens (Fée) Staiger & Kalb

Biblioth. Lichenol. 85: 109 (2002).—*Graphis marcescens* Fée, *Essai Crypt. Exot.* (Paris) 1: 38 (1825).

(Fig. 1)

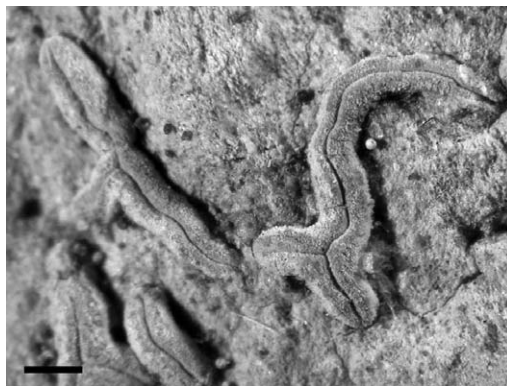


FIG. 1. *Carbacanthographis marcescens*, habitus (76.584—AMH). Scale = 1mm

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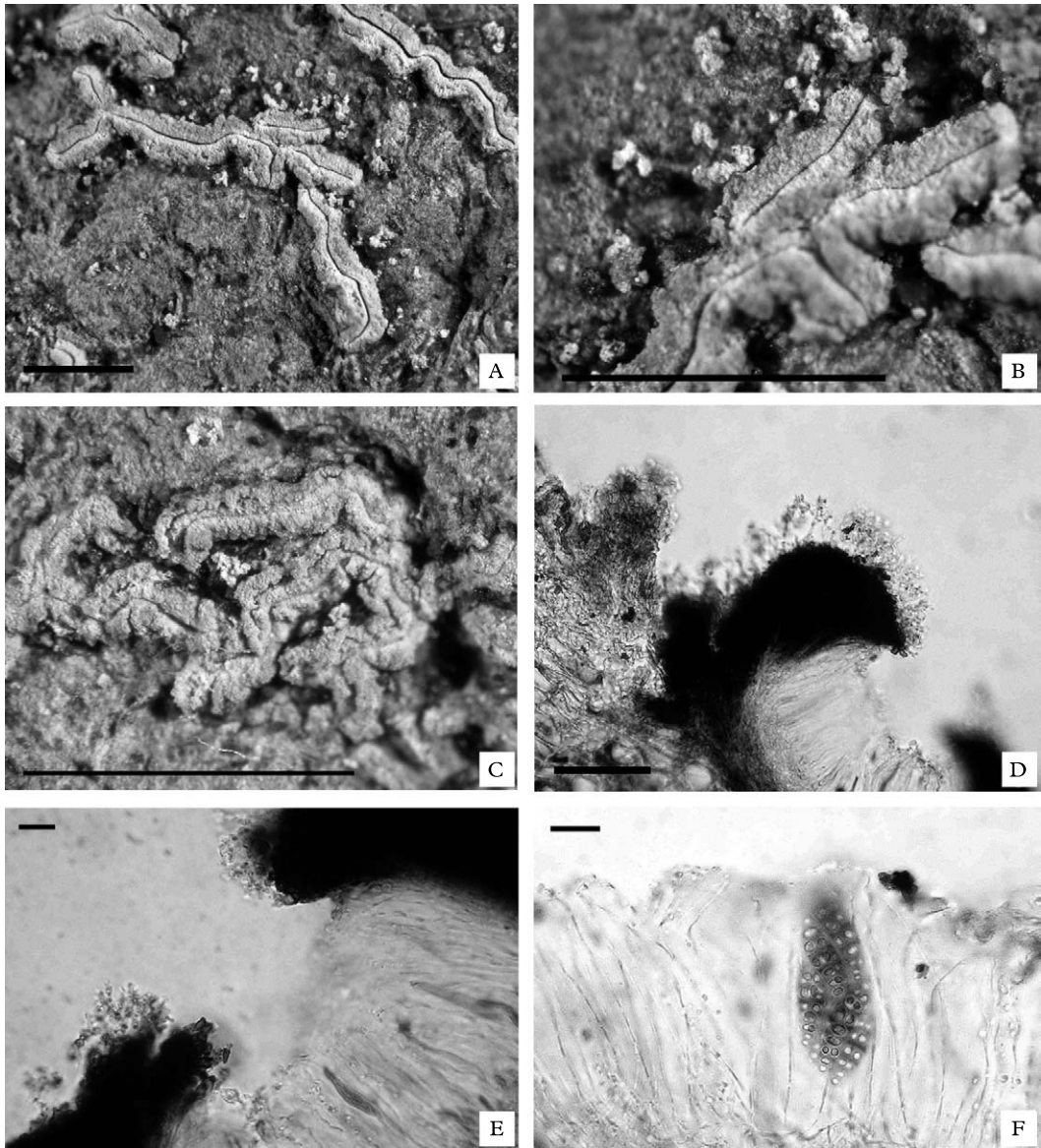


FIG. 2. *Carbacanthographis sorediata* (holotype, AMH). A–C, habitus; D, vertical section of ascocarp and soralium; E, warty periphysoids; F, ascospores. Scales: A–C = 1mm; D = 50μm, E–F = 10 μm.

Remarks. *Carbacanthographis marcescens* has earlier been recorded from India as *Graphina marcescens* Fée (Patwardhan & Kulkarni 1976; Makhija *et al.* 1992) and can easily be identified by its laterally carbonized exciple, warty periphysoids, powdery, white thalline cover, small muriform ascospores,

and by the presence of salazinic, protocetraric and norstictic acids in the thallus. The species is widely distributed and occurs in Australia, Brazil, Cameroon, Cuba, Guyana, India, Solomon Islands, Thailand, and the USA. In India it has been collected in the evergreen forests of Kerala and Tamil

Nadu situated in the Western Ghats and in the tropical evergreen rain forest of Andaman Islands. Corticolous pyrenocarpous and graphidaceous lichens and the thelotremes predominate in the lichen biota of the Andaman Islands.

Specimens examined (all AMH). **India:** *Andaman Islands:* South Andaman, Tarmugli Island, near Wandoor, 1985, P. K. Sethy & P. G. Patwardhan 85.1945, 85.1946; Redskin Islands, Wandoor, 1985, P. K. Sethy & M. B. Nagarkar 85.1991, 85.1992; *ibid.*, P. G. Patwardhan & M. B. Nagarkar 85.1999, 85.2000, 85.2002, 85.2006, 85.2007. *Kerala:* Munnar-Kodai Road, below Yellapattii, 1976, P. G. Patwardhan & M. B. Nagarkar 76.584; Cardamom hills, Devicolam-Kumily Road, 17 km from Devicolam, 1976, P. G. Patwardhan & A. V. Prabhu 76.695; Thekadi, near Periyar house, 1976, P. G. Patwardhan & M. B. Nagarkar, 76.949. *Tamil Nadu:* Kodaikanal, Silver Cascade, 1975, P. G. Patwardhan & A. V. Prabhu 75.60, 75.406, 75.420, 75.421; Kodaikanal, Kodai-Munnar Road, 10 km to Berijam lake, 1975, P. G. Patwardhan & A. V. Prabhu 75.128, 75.160; Kodaikanal, near Golf Club, 1975, P. G. Patwardhan & A. V. Prabhu 75.189; Dastoor Villa, Kodai lake, 1975, P. G. Patwardhan & A. V. Prabhu 75.330, near Daisy Bank, 1975, P. G. Patwardhan & A. V. Prabhu 75.356.

Carbacanthographis sorediata B. O. Sharma, Makhija & Khadilkar sp. nov.

Similis *Carbacanthographide marcescente* sed thallo sorediatio, ascosporis majoribus et acido consalazinic differt.

Typus: India, Tamil Nadu, Agasthyamalai (Agasthi hills), Upper Kodayar, 24 January 1983, P. G. Patwardhan & P. K. Sethy 83.250 (AMH—holotypus)

(Fig. 2A–F)

Thallus crustose, corticolous, epiphloeodal, greenish grey, finely cracked, with a thin pseudocortex, sorediate; *soralia* whitish, granular, with the photobiont layer being pushed upwards by vertical hyphae in the thallus (Fig. 2D).

Ascocarps lirellate, conspicuous, light pinkish to creamy, emergent, undulate, with conspicuous powdery pruinose cover, simple to branched, curved, up to 4 mm long, ends acute or round. *Disc* slit-like, covered laterally with light pinkish pruina and coated with warty periphysoids. *Proper exciple* convergent, laterally carbonized, base brown. *Epithecium* absent. *Hymenium* hyaline, not



FIG. 3. Distribution of *Carbacanthographis* species in India; ● *C. marcescens*, ■ *C. sorediata*.

impersed, I–, 60–100 µm high. *Paraphyses* simple. *Periphysoids* short, distinctly warty. *Asci* 8-spored. *Ascospores* hyaline, fusiform, submuriform, with 7–8 transverse and 1–2 longitudinal septa per segment, 17.5–27.5 × 7.5–10 µm, I+ colour reaction weak.

Chemistry. Salazinic and consalazinic acids present.

Remarks. *Carbacanthographis sorediata* stands distinct amongst all the known species of *Carbacanthographis* in having a sorediate thallus with a unique type of soralia: in sections it appears as if the photobiont layer is pushed upwards by vertical hyphae in the thallus, to eventually form the soralia. *Carbacanthographis marcescens* can be differentiated in lacking soralia and having smaller ascospores of 12–17 × 5–7 µm, and a slightly different chemistry. *Carbacanthographis amicta* (Nyl.) Staiger & Kalb and *C. salazinic* also contain salazinic acid, but differ from the new species in having a thallus without soredia and a completely carbonized exciple.

The new species *Carbacanthographis sorediata* is confined to the Western Ghats

(Fig. 3), which form a practically unbroken relief dominating the western coast of the Indian peninsula for almost 1600 km. From a botanical point of view, the Western Ghats occupy a special position on the Indian sub-continent for their interesting flora and are one of the richest lichen sites in India. The species was collected in the Agasthyamalai

(Agasthi hills) in tropical moist ever-green montane forests at an elevation of c. 1800 m.

Additional specimens examined. India: Tamil Nadu: Agasthyamalai (Agasthi hills), Upper Kodayar, 1983, P. G. Patwardhan & P. K. Sethy 83.249, 83.356, 83.357 (AMH).

World-wide key to the species of *Carbacanthographis*

- 1 Thallus isidiate or sorediate 2
 Thallus neither isidiate nor sorediate 3
- 2(1) Thallus isidiate; asci (4–) 6–8-spored; protocetraric acid present; Australia
 **C. hertelii Kalb & Staiger**
 Thallus sorediate; asci 8-spored; salazinic and consalazinic acid present; India . . .
 **C. sorediata B. O. Sharma et al.**
- 3(1) Excipular base not carbonized 4
 Excipular base carbonized 8
- 4(3) Ascospores trans-septate 5
 Ascospores muriform 6
- 5(4) Norstictic acid present; Vietnam **C. induta (Müll. Arg) Lücking**
 Stictic acid present; Japan
 **C. iriomotensis (M. Nakan.) M. Nakan. & Kashiw.**
- 6(4) Salazinic acid (major), protocetraric and norstictic acid (trace) present; ascospores
 12–17 × 5–7 µm; Australia, Brazil, Cuba, Dominica and India
 **C. marcescens (Fée) Staiger & Kalb**
 Stictic acid present 7
- 7(6) Asci 1-spored; ascospores c. 100 µm long **C. cleitops (Fée) Lücking**
 Asci 6–8-spored; ascospores 47–75 × 18–30 µm; Cuba, Dominica
 **C. triphoroides (M. Wirth & Hale) Lücking**
- 8(3) Ascospores trans-septate 9
 Ascospores muriform 12
- 9(8) Ascospores 4 locular; asci 8-spored; ascospores 18–20 × 8–10 µm; psoromic acid
 present; Solomon Islands **C. alloafzelii (A.W. Archer) A.W. Archer**
 Ascospores more than 4 locular 10
- 10(9) Ascospores large, more than 50 µm long; asci 4–8-spored; ascospores 55–100 × 7–
 9 µm; protocetraric and lichexanthone present; Brazil, Paraguay
 **C. candidata (Nyl.) Staiger & Kalb**
 Ascospores small, less than 50 µm long 11
- 11(10) Ascospores 23–35 × 6–7 µm in size; stictic, constictic, menegazzic and hypostictic
 acids present; Brazil **C. stictica Staiger & Kalb**
 Ascospores 20–25 × 6–8 µm; protocetraric and lichexanthone acids present; Brazil
 **C. chionophora (Redinger) Staiger & Kalb**

- 12(8) Lichen substances absent; asci 8-spored; ascospores 20–40 µm long; Brazil
 **C. coccospora (Aptroot) Aptroot & Lücking**
 Lichen substances present 13
- 13(12) Ascospores more than 50 µm long 14
 Ascospores less than 50 µm long 15
- 14(13) Asci 8-spored; ascospores 55–90 × 11–18 µm; protocetraric acid and lichexanthone
 present; Brazil **C. subalbotecta Staiger & Kalb**
 Asci 1-spored; ascospores 120–180 × 25–30 µm; stictic, constictic and cryptostictic
 acids present; Brazil **C. crassa (Müll. Arg.) Staiger & Kalb**
- 15(13) Salazinic acid present 16
 Salazinic acid absent 17
- 16(15) Ascospores 14–18 × 6–7 µm; only salazinic acid present; New Pacific and Japan .
 **C. amicta (Nyl.) Staiger & Kalb**
 Ascospores 19–23 × 7–8 µm; salazinic (major), consalazinic, norstictic and protoce-
 traric (trace) acids present; Australia, Indonesia
 **C. salazinic (A.W. Archer) A.W. Archer**
- 17(15) Ascospores 22–26 × 10–12 µm; subpsoromic acid present; Solomon Islands
 **C. hilli (A.W. Archer) A.W. Archer**
 Ascospores 14–18 × 6–7 µm; protocetraric acid present; South America
 **C. inspersa Staiger**

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