

A new lichenicolous *Arthonia* species (*Arthoniaceae*) on *Diorygma* from India

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Abstract: A new lichenicolous ascomycete, *Arthonia diorygmae*, is described from the thallus and ascomata of *Diorygma junghuhmii*. The new species is characterized by rounded to irregular, applanate to convex ascomata up to 0.3 mm in diameter, a slightly whitish pruinose disc, transversely 1-septate, hyaline to greyish ascospores (13–)14–15(–21) × 5–7 µm, and its lichenicolous habitat. It is known from the subtropical region of the Western Ghats in India and appears to be widespread due to the large distribution of the host species.

Key words: *Graphidaceae*, lichen, parasite, taxonomy, Western Ghats

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Introduction

More than 1800 lichenicolous species of fungi are known which live on lichens as host-specific parasites, pathogens, saprotrophs and commensals (Lawrey & Diederich 2003). The genus *Arthonia* (*Arthoniaceae*, *Arthoniales*) accommodates *c.* 500 species worldwide (Grube 2004). Out of these, *c.* 110 ascomycetes are described from different facultative lichenicolous fungi (Lawrey & Diederich 2011). Lichen-inhabiting fungi in the Indian subcontinent are little studied, perhaps due to a lack of knowledge of their substratum specificity. Some examples reported from Nepal and India are: *Arthonia destruens* var. *nana* Grube & Hafellner reported from central Himalaya (Nepal), inhabiting *Xanthoria fallax* (Hepp) Arnold (Grube *et al.* 1995); *Polysporina lapponica* (Ach. ex Schaer.) Degel. [= *P. dubia* (H. Magn.) Vězda] from the western and north-west Himalayas (India), growing on *Acarospora* (Awasthi 1991); and *Lichenopeltella swaminathaniana* Hariharan *et al.* from the Eastern Ghats (India) on *Porina* species

(Hariharan *et al.* 1996). During ongoing research into lichenicolous, lichenized and non-lichenized fungi of the tropical and subtropical regions in India, several noteworthy samples of lichens were collected and preserved. A re-examination of herbarium specimens resulted in the identification of an interesting *Arthonia* species growing luxuriantly on *Diorygma junghuhmii*. The species *A. diorygmae* is recognized as a lichenicolous fungus and described here as new to science.

Material and Methods

Specimens of lichens preserved in the herbarium of the CSIR-National Botanical Research Institute, Lucknow (LWG), were studied. Morphological and anatomical characters were examined using stereozoom (LECIA S8AP0) and compound (LECIA DM500) microscopes, respectively. The colour tests and thin-layer chromatography in solvent system A were performed following Orange *et al.* (2001). Lugol's solution (I) was used to check the amyloidity in asci, interascal filaments and ascospores.

The New Species

***Arthonia diorygmae* S. Joshi & Upreti
sp. nov.**

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Arthonia diorygmae is differentiated from other 1-septate, lichenicolous *Arthonia* species in having immersed, finally

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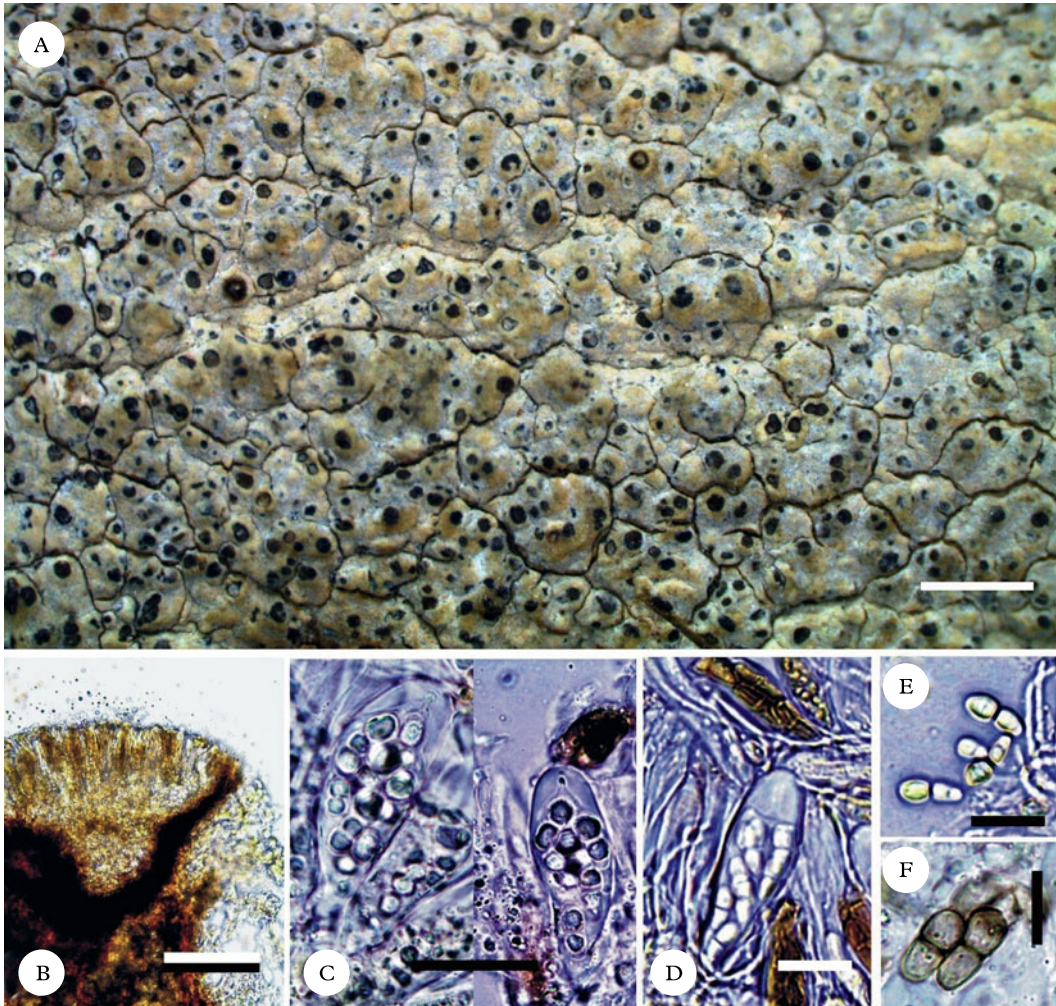


FIG. 1. *Arthomia diorygmae*. A, habit & habitat (holotype); B, cross-section of ascomata; C & D, ascus with ascospores; E, colourless ascospores; F, ascospores at maturity. Scales: A = 1 mm; B = 100 μ m; C & E = 20 μ m; D & F = 15 μ m. In colour online.

flattened to \pm convex, roundish to irregular ascomata, a slightly whitish pruinose disc, densely interspersed interascal filaments, large asci (40–57 \times 10–18 μ m), ascospores (13–)14–15(–21) \times 5–7 μ m and *Diorygma junghuhnii* as host species.

Type: India, Palni Hills, Perumalmalai area, on bark, 5 January 1970, D. D. Awasthi & K. P. Singh 70.425 (LWG—holotype).

(Fig. 1A–F)

Ascomata apothecia, arthonioid, scattered to crowded, \pm evenly distributed, scarcely

confluent in groups of two, at first immersed later erumpent, appearing level with the thallus in older ascomata, appanate to \pm convex, roundish to irregular in shape, up to 0.3 mm diam., in section they exhibit an undulating V-shaped structure, up to 160 μ m tall. *Disc* dark brown, gelatinous, slightly whitish pruinose, 0.10–0.25 mm diam. *Epithecioid* layer hyaline to brownish to olivaceous (5–) 10–15(–20) μ m high, continuous with the parathecioid layer, K+ slightly purplish, I+

wine red, KI+ wine red. *Parathecioid* layer brown to dark brown or olivaceous, (10–)15–20(–30) μm thick; *ascigerous* layer hyaline, (45–)60–70 μm high. *Interascal* filaments paraphysoidal, anastomosingly branched, 1–2 μm thick, densely conglutinate and interspersed, apically swollen and branched, hymenial gel between the filaments I+ blue, KI+ blue to wine red. *Hypothecioid* layer hyaline to reddish brown later, 20–30(–40) μm high, I+ wine red, KI+ wine red. *Asci* clavate, 8-spored, stiped, outer wall I+ blue, KI–, epiplasm I+ wine red, KI+ wine red, 40–57 \times 10–18 μm . *Ascospores* hyaline, becoming smoky to greyish at maturity, transversely 1-septate (2-celled), ovoid to slipper-shaped, constricted at the septum, the upper cell slightly thicker than lower, perispore distinct, up to 1 μm thick, I–, KI–, (13–)14–15(–21) \times 5–7 μm .

Chemistry. Apothecia (*A. diorygmae*): K–, PD–, C–. Thallus (host species): K+ yellowish red, PD+ yellow, C–; norstictic acid detected by TLC.

Etymology. The species name refers to the host lichen genus *Diorygma*.

Ecology and distribution. *Arthonia diorygmae* is reported from the eastward spur of the Western Ghats in India. The species flourishes with other lichenized or non-lichenized fungi growing on the trees of tropical rainforests in the Perumalmalai hills of Tamil Nadu, at an altitude of 1320 m. The host lichen *Diorygma junghuhnii* grows in the evergreen (rain) forests of the Western Ghats, the eastern Himalayas and the Eastern Ghats in India. Recent collections confirm the expanded distribution of the host species to the north-west Himalayas. Hence, *Arthonia diorygmae* may also have a wider distribution in India.

Remarks. No lichenicolous fungi have ever been described from *Diorygma*. However, a few have been recorded from other species in the family *Graphidaceae*. *Arthonia diorygmae* shows a parasitic life form on *Diorygma junghuhnii* (*Graphidaceae*), spreading over the host thallus and restricting the development of ascocarps. The species is distin-

guished from other species of lichenicolous *Arthonia* with 1-septate spores by its unique habitat on *Diorygma junghuhnii*, immersed to \pm erumpent ascomata up to 160 μm high in cross-section, dark brown, mostly irregular, slightly whitish pruinose discs, an undulating brown parathecioid layer, a K+ purplish epithecioid layer, an ascigerous layer up to 70 μm high, asci 40–57 \times 10–18 μm , slipper-shaped and hyaline, smoky to dark greyish ascospores of (13–)14–15(–21) \times 5–7 μm .

Almost all 1-septate *Arthonia* share a similar range of apothecial and ascospore size. The new taxon most closely resembles *Arthonia amylospora* Alm., which has an \pm appanate ascomatal disc 0.10–0.35 mm diam., colourless ascospores 13–21 \times 5–8 μm (16–24 \times 6–10 μm) (Ihlen & Wedin 2008; Coppins & Aptroot 2009) and lacks a visible vegetative thallus but differs in being commensalistic on *Porpidia rugosa*, in having mostly immersed ascomata gathered in small clusters, the lack of a K+ purplish pigment in the epithecioid layer, a pale brown ascigerous region (40–55 μm high) and K/I+ blue ascospores.

Arthonia peltigerea Th. Fr., *A. semi-immersa* Wedin & Hafellner, *A. punctella* Nyl., *A. destruens* Rabenh. and *A. plectocarpoides* (S. Y. Kondr. & D. J. Galloway) Wedin & S. Y. Kondr. also have similar ascospore sizes of 15–20 \times 5–7 μm , c. 14.5–18.0 \times 5–7 μm , 12–17 \times 5.0–7.5 μm , 10.5–17.0 \times 5–7 μm and 11–17 \times 4.0–6.5 μm , respectively. *Arthonia peltigerea* is a weak parasite on the thallus of *Peltigera rufescens*, has somewhat hemispherical ascomata 0.3–1.5 mm diam. and a pale brown, 45–50 μm tall, ascigerous layer. *Arthonia semi-immersa* Wedin & Hafellner, although having a similar hymenium size (60–70 μm), hyaline ascospores and a parasitic mode of action similar to that of *A. diorygmae*, has an entirely different lecideoid ascomatal origin, with immersed to superficial (after rupturing the host cortex) ascomata arranged in a row of 3–5 in a fissured cortex and with ascospores lacking a perispore. *Arthonia punctella* is most probably an endemic species to the British Isles, with slightly smaller ascomata, 0.07–0.20 mm diam., ascospores which soon become brown

and warty, and is commensalistic on the thallus of *Diplotomma*. *Arthonia destruens* Rabenh., a local parasite on *Physcia stellaria* and *Xanthoria parietina*, has ascomata \pm crowded in groups of 10, a yellowish hymenium containing an amorphous pigment and 4–8-spored asci. *Arthonia plectocarpoides* has a hypothecoid layer, 45–55 μm high, and is distinctly cecidogenous (gall forming) on *Pseudocyphellaria scabrosa* and alpine species of *Heterodermia*. All the above species, except *Arthonia destruens*, lack a K⁺ purplish epithecoid layer. Other similar *Arthonia* species, with a K⁺ purplish epithecoid layer, include *A. cohabitans* Coppins, *A. neglectula* Nyl., and *A. destruens* var. *nana* Grube & Hafellner. *Arthonia cohabitans* differs in lacking an epithecoid layer in mature ascomata, has an indistinct parathecioid layer, a yellowish brown ascigerous layer and lives on *Arthothelium macounii*. *Arthonia neglectula* has much smaller ascospores of 7–10 \times 3–4 μm , and grows on the sterile sorediate crust of *Lepraria*. The sympatric *Arthonia destruens* var. *nana* Grube & Hafellner, with dispersed ascomata and a parathecioid layer formed by down-turning of epithecium, is similar to the new taxon but is clearly distinguished by having comparatively small, 0.09–0.17 mm diam. ascomata, a pigmented ascigerous layer, 4–8-spored asci with an indistinct foot, 10.5–13.0 \times 5–7 μm ascospores and occurring on *Xanthoria fallax*.

The family *Graphidaceae* comprises a large group of tropical and subtropical species.

In India the family is represented by c. 408 species (c. 24 of *Diorygma*), with the majority occurring in the rainforests of the north-east Himalayas and the Western Ghats. The wide distribution of different groups of *Graphidaceae* in wet conditions enhances the possibility of overgrowth by non-lichenized fungi. In addition to the new taxon described here from India, only two additional parasitic *Arthonia* species are known to occur on *Graphidaceae*: *Arthonia graphidicola* Coppins and *A. thelotrematis* Coppins. *Arthonia graphidicola*, on the thallus of *Graphis scripta*, shows a resemblance to the new species in having colourless ascospores of similar dimensions (13–17 \times 4.5–5.5 μm). It has earlier been recorded from the British Isles as endemic, but also occurs in France, Spain and Luxembourg (Coppins 1989; Coste 1993, 1997; Etayo & Diederich 1998). It is very different because of the smaller apothecia which are 0.06–0.16 mm in diam. or elongate, fleck-like with pointed ends, up to 0.42 \times 0.06–0.10 mm, with a pale reddish brown ascigerous layer (40–50 μm high) and 2–3-septate ascospores. Similarly, *A. thelotrematis* reported by Coppins (1989) also differs from *A. diorygmae* in having the same apothecial morphology and ascospore septation as that of *A. graphidicola*, in addition to a comparatively smaller ascigerous layer (33–35 μm high) and ascospores (11–14 \times 4.5–5.0 μm), and parasitic being on the thallus of *Thelotrema lepadinum*.

Key to *Arthonia* species growing on *Graphidaceae*

- 1 Ascospores 1-septate, ascomata up to 0.3 mm, slightly pruinose, spores hyaline to greyish in late maturity; growing on *Diorygma junghuhnii*. **A. diorygmae**
- Ascospores 2–3-septate, ascomata epruinose, ascospores brown-warty at maturity; host lichen different. 2
- 2(1) Ascospores 13–17 \times 4.5–5.5 μm , ascomata 0.06–0.16 mm diam.; hypothecium colourless; growing on *Graphis scripta*. **A. graphidicola**
- Ascospores 11–14 \times 4.5–5.0 μm , ascomata 0.06–0.20 mm diam.; hypothecium reddish brown; growing on *Thelotrema lepadinum*. **A. thelotrematis**

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