

Graphis koreana (Graphidaceae, Ostropales), a new species from South Korea

Santosh JOSHI, Young Jin KOH, László LÖKÖS, Udeni JAYALAL and Jae-Seoun HUR

Abstract: A saxicolous *Graphis* discovered in the southern part of South Korea is described as new to science. The new species, *Graphis koreana* sp. nov., is characterized by a green to brownish green, thick, rimose thallus, completely carbonized proper exciple, trans-septate to submuriform ascospores and the presence of norstictic acid.

Key words: lichen, norstictic acid, taxonomy

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Introduction

The cosmopolitan genus *Graphis* Adans. (Graphidaceae, Ostropales, Ascomycota) comprises c. 330 species worldwide (Lücking 2009; Lücking *et al.* 2009). To clarify the taxonomy of the genus, a comprehensive study was conducted (Lücking *et al.* 2009), which included in *Graphis* species with rounded to lirellate or pseudostromatic ascospores, mostly carbonized proper exciple, non-amyloid, functionally unitunicate asci with apical wall thickening, hyaline and amyloid, trans-septate to muriform ascospores with lens-shaped lumina, and *Trentepohlia* as photobiont (Staiger 2002; Lücking *et al.* 2009).

South Korea has a high diversity of lichen-forming fungi in the southern regions of the country (Hur *et al.* 2004, 2005). However, the genus *Graphis* is poorly studied and previous collections seem to have, to date, neglected this genus from the South Korean mycota, as indicated by only 13 species being recorded from different provinces (Hur *et al.*

2005): *Graphis anfractuosa* (Eschw.) Eschw., *G. cervina* Müll. Arg., *G. cognata* Müll. Arg., *G. dupaxana* Vain., *G. handelii* Zahlbr., *G. intricata* Eschw., *G. proserpens* Vain., *G. intermediella* Stirt. [= *G. rikuzensis* (Vain.) M. Nakan.] and *G. scripta* (L.) Ach., as well as the four recently added species *G. aperiens* Müll. Arg., *G. flavopalmicola* Y. Joshi *et al.*, *G. jejuensis* K. H. Moon, and *G. psunodae* Zahlbr. (Joshi *et al.* 2010; Moon *et al.* 2012).

In the course of an ongoing survey of crustose lichens from sub-temperate regions of the country and material preserved in the herbarium of the Korean Lichen Research Institute (KoLRI), an interesting and novel specimen of *Graphis* was identified. The species is characterized by an olive-green to ± brownish green, rather thick thallus, complete thalline margin, black, lirellate ascospores, concealed disc, entire labia, completely carbonized proper exciple, mostly trans-septate to submuriform ascospores and a saxicolous habitat.

Materials and Methods

The material was examined with a SMZ-168 dissecting microscope (China) and BX-50 compound microscope (Olympus, Tokyo, Japan). Thin, hand-cut sections were observed on material mounted in water, 10% KOH solution, Lugol's iodine (I) and lactophenol Cotton Blue

S. Joshi, Y. J. Koh, U. Jayalal and J.-S. Hur (corresponding author): Korean Lichen Research Institute, Suncheon National University, Suncheon 540-742, South Korea. Email: jshur1@sunchon.ac.kr

L. Lökös: Department of Botany, Hungarian Natural History Museum, H-1476 Budapest, Pf. 222, Hungary.

(LB). All measurements were taken under higher magnification of $\times 40$ and $\times 1000$ prior to application of KOH. Lichen substances were identified by thin-layer chromatography (solvent systems C and A) and colour spot tests as described by Orange *et al.* (2010).

The Species

Graphis koreana S. Joshi & Hur sp. nov.

Mycobank No.: MB 803015

Similar to *Graphis assimilis*, but differing in having a green thallus, complete thalline margin and saxicolous habit.

Type: South Korea, Jeollanam-do, Goheung-gun, Jeomam-myeon, Mt Palyeongsan, Yuyeongbong, 34°37'824"N, 127°25'701'E, alt. c. 465 m a.s.l., on rocks, Y. Joshi, S. Jeon & G. S. Han 100294 (KoLRI-holotype).

(Figs 1 & 2)

Thallus saxicolous, epilithic, crustose, corticate, continuous, rimose-cracked, smooth to rough, epruinose, dull, olive-green to \pm brownish green, 300–500 μm thick in cross-section. *Cortex* 20–30 μm thick. *Photobiont* layer up to 100 μm thick. *Medulla* whitish to creamish, up to 400 μm thick with inclusions of crystals. *Prothallus* indistinct to blackish.

Ascomata lirelliform, immersed to \pm erumpent (scarcely raised above the thallus). *Lirellae* completely covered by thalline margin (10–12 μm thick), short to 5 mm in length, ends mostly rounded. *Labia* entire, greyish to blackish, covered by thin cortex. *Disc* slit-like, epruinose, concealed. *Proper exciple* entire, completely carbonized, convergent, \pm round, thin to basally thick, 30–60 μm wide. *Epihymenium* indistinct to absent. *Hymenium* hyaline, not interspersed, 100–120 μm high, I–; *paraphyses* simple, rather lax, apically granulate, \pm conglutinate, 1–2 μm thick. *Hypothecium* hyaline, indistinct to 20 μm high, I–. *Ascus* clavate, 8-spored, with distinct stipe (up to 30 μm long), 130–135 \times 20–27 μm , I–. *Ascospores* hyaline, clavate to ellipsoid with rounded ends, mostly transversely 9–12-septate with one longitudinal septum in the middle locules, (33–)35–45(–50) \times 10–12 μm , locules angular with rounded ends, immature ascospores distinctly halonate, halo up to 6 μm thick, I+ violet to blue.

Etymology. The specific epithet refers to the country from where the new taxon is being described.

Chemistry. Thallus and medulla K+ yellow turning red, P+ yellow-orange, C–, KC–; norstictic acid detected by TLC.

Distribution and ecology. The new species is known only from the type locality (Mt Palyeongsan, Jeollanam-do) in South Korea, where it was widely dispersed on rocks and collected at an altitude of c. 465 m. Mount Palyeongsan is a mountain range of steep and undulating geographical forms reaching an altitude of around 600 m. The type locality is situated in the southern part of the country and characterized by granite and gneiss rocks with mixed tree vegetation of spruce and Korean pine. Other species of lichens reported from the locality are *Porpidia albocaerulescens* (Wulfen) Hertel & Knoph, *Cladonia scabriuscula* (Delise) Leight., *Caloplaca cinnabarina* (Ach.) Zahlbr. and several members of *Lecanoraceae*, *Parmeliaceae*, *Stereocaulaceae* and *Verrucariaceae*.

Remarks. The new species is well characterized by a green (dark green to brownish green or bluish green), thick thallus, lirellae with complete thalline margin and entire labia, completely carbonized, convergent proper exciple, transversely septate ascospores with one longitudinal septum frequently in the middle lumina, and the presence of norstictic acid as a secondary compound.

Graphis assimilis Nyl. closely resembles *G. koreana* in having entire labia, short, sparsely branched lirellae, 30–45 μm long ascospores, and a thallus containing norstictic acid, but differs in that it has ascomata with a lateral thalline margin and hence shows a different lirellae morphology (*limeola*-morph). Furthermore, *G. assimilis* is corticolous and has a white thallus, while the new species grows on rocks with a green thallus. *Graphis koreana* is also comparable to *G. caesiocarpa* Redinger in having a concealed disc, entire labia, transversely septate ascospores, and norstictic acid, but *G. caesiocarpa* has lirellae of the *caesiella*-morph (with pruina), 5–7 septate, small ascospores 15–20 \times 5–6 μm in size,

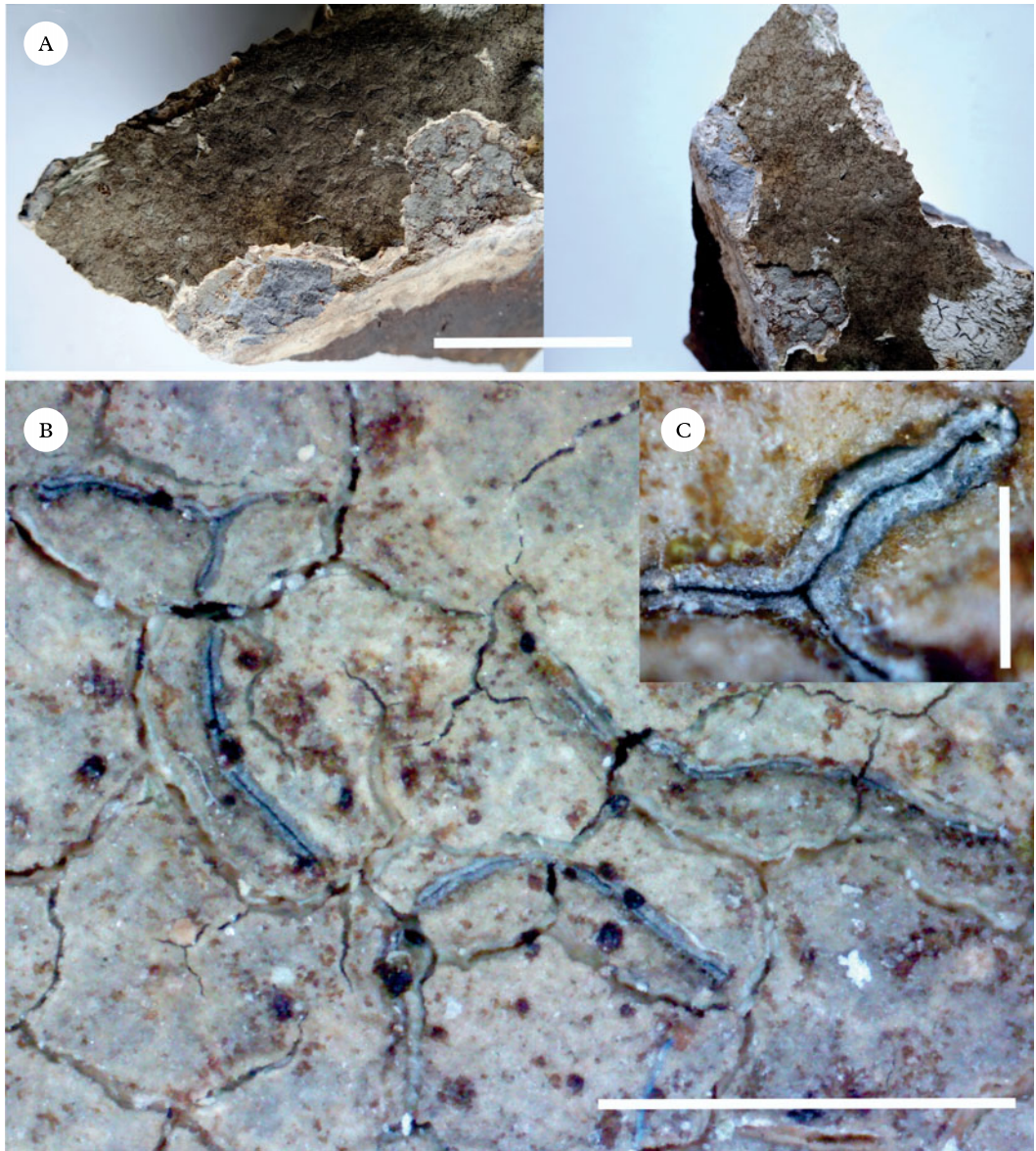


FIG. 1. *Graphis koreana* (holotype). A, habitat; B, habit; C, ascomata. Scales: A = 3 cm; B & C = 1 mm.

and lirellae with a lateral thalline margin (Lücking *et al.* 2009). *Graphis kollaimalaiensis* Adaw. & Makhija, another similar species with a concealed disc and entire labia, has somewhat larger ascospores (*c.* 45–70 μm) and a different lirellae morphology (*hosseimorph*). Similarly, *G. assamensis* Nagarkar &

Patw. is separated from the new species in having erumpent lirellae and a thallus that produces stictic and salazinic acids as chemical compounds.

Among the *Graphis* species reported from Korea, *Graphis aperiens* shares some characteristics with *G. koreana*, such as a com-



FIG. 2. *Graphis koreana* (holotype). A, completely carbonized exciple; B, ascus with ascospores; C, ascospores (note the distinct halo in the immature ascospore, arrow). Scales: A = 100 µm; B = 50 µm; C = 20 µm.

pletely carbonized excipulum, transversely septate ascospores, and the presence of norstictic acid, but differs in having an exposed, white-pruinose disc and lirellae with lateral thalline margin (*scripta*-morph), interspersed hymenium, and small ascospores of 20–35 µm with less transverse septa. *Graphis cervina*, the only saxicolous species previously reported from South Korea, has lirellae of the *lineola*-morph, small ascospores 15–25 µm long, and produces stictic acid in addition to norstictic acid. Moreover, the new

taxon frequently has a vertical septum in the middle locules.

Among species with muriform ascospores, *Graphis koreana* seems to be closest to *G. cremicolor* (H. Magn.) Lücking & Archer and *G. nadurina* Aptroot, which have 20–50 µm long ascospores and contain norstictic acid. *Graphis cremicolor* also agrees in the saxicolous habit, but it differs in having lirellae with a lateral thalline margin, whereas *G. nadurina* has short unbranched lirellae (*cleistomma*-morph) and 2-spored asci.

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