

## Article

# Notes on Graphidaceae in Macaronesia, with Descriptions of Four New Species

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**Abstract:** A survey of the lichen family Graphidaceae in Macaronesia (Madeira, the Canary Islands, and the Azores) is presented, with detailed treatments for the genera *Allographa*, *Fissurina*, and *Graphis*. All other species are listed and new records provided. A key to all Graphidaceae known from Macaronesia, except the thelotremoid species, is presented. The following species are newly described: *Fissurina azorica*, *Fissurina elaiocarpoides*, *Fissurina nigrolabiata*, and *Topeliopsis juniperina*. Many species are newly recorded for one or more islands of the three archipelagos.

**Keywords:** archipelago; biodiversity; Macaronesia; new species; taxonomy

## 1. Introduction

An extensive field study of lichens and lichenicolous fungi in Macaronesia, in particular the Azores and Madeira (Figure 1), by the first author showed that the lichen diversity of these islands is still incompletely known [1–3]. Here we present results for the family Graphidaceae. The presence of this conspicuous family in Macaronesia has already received considerable attention. Records are summarized in various checklists [4–6]. Lücking & Breuss [7] published a key for the thelotremoid species in Macaronesia and accepted nine species. Our new fieldwork contributed in particular to the genera *Fissurina*, *Graphis*, and *Topeliopsis* and the results are presented here. For each species the presence on the Azores archipelago (A), the Madeira archipelago (M) and the Canary Islands (C) is indicated.



**Figure 1.** Map with the major island groups of Macaronesia.

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## 2. Materials and Methods

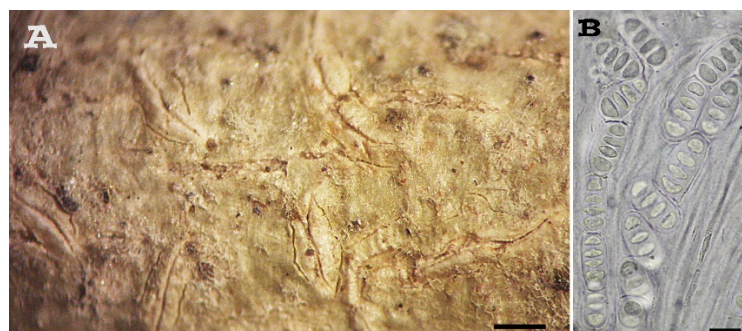
The material examined was collected by the first author and his wife on the Macaronesian islands Madeira, Faial, Graciosa, Pico, Santa Maria, São Jorge, São Miguel, Terceira, and some of the Canary Islands. Specimens were studied in the usual way with a stereo microscope and a compound microscope with tap-water mounts. Chemical compounds were studied by thin-layer chromatography (TLC) using solvent systems A, B, and C [8], and fluorescence under long-wave UV light. Vouchers are deposited in the herbaria of the first author and B.

## 3. Results and Discussion

### 3.1. *Fissurina*

In the checklist of [6], only one species of *Fissurina* is listed, *F. quadrispora* Kalb. However, two more species are included under the synonyms *Graphis insidiosa* (C. Knight & Mitt.) Hook. and *Graphis triticea* (Nyl.) Staiger. In the checklist of [4], four species are listed: *Fissurina dumastii* Fée, *F. insidiosa* (C. Knight & Mitt.) Hook., *F. quadrispora* and *F. triticea* (Nyl.) Staiger. It appears that our numerous specimens from the Azores mostly differ from those species and belong to three newly described species, *F. azorica*, *F. elaiocarpoides*, and *F. nigrolabiata*. Five further *Fissurina* species are listed for Macaronesia, *F. consentanea* (syn. *F. triticea*), *F. aff. dumastii*, *F. aff. instabilis*, *F. aff. khasiana*, and *F. quadrispora*.

*Fissurina azorica* van den Boom, Sipman & Lücking sp. nov. (Figure 2)  
MB849164 A+, C-, M-.



**Figure 2.** *Fissurina azorica* (holotype). (A) Habitus, scale = 1 mm; (B) Ascospores, scale = 10 µm.

**Diagnosis:** Similar to *Fissurina elaiocarpoides* in habitus, but different in lirellae 1.5–2.5 × 0.2–0.5 mm vs. 0.3–1.5 × 0.15–0.25 mm, ascospores three-septate, 17–22 × 8–10 µm vs. muriform, 20–25 × 10–12 µm, I- vs. I+ weakly violet-blue.

**Holotype:** Portugal, Azores, *São Jorge*, NW of Velas, 3 km NW of Rosais, Reserva Florestal das Sete Fontes, a mixed forest including many *Camellia* shrubs. 38°44.15' N, 28°15.73' W, 415 m, 3 September 2017, P. & B. van den Boom 56945 (hb. v.d. Boom).

**Etymology:** The epithet refers to the archipelago where the species occurs.

**Thallus** epiperidermal, corticate, smooth, whitish to pale greenish, up to 0.15 mm thick. **Ascomata** lirellae, erumpent, conspicuous labia slightly thickened (almost hemithecioid), with brownish line, 1.5–2.5 × 0.2–0.5 mm; excipulum distinct, paraplectenchymatous, olive-yellow, not carbonized, tips darkened (brownish), without periphysoids above the hymenium; disc concealed; hymenium not inspersed, 120–160 µm, hyaline; paraphyses 1–1.5 µm wide, apically sometimes slightly widened and smooth. **Ascus** cylindrical, 70–80 × 16–20 µm, eight-spored, sometimes uniseriate. **Ascospores** abundantly present, three-septate, 17–22 × 8–10 µm, with thickened septa and lens-shaped lumina and slightly thickened wall, thin perispore up to 1.5 µm wide, I-negative.

**Chemistry:** K-, C-, P-, UV-, no chemical compounds detected by TLC.

**Distribution and ecology:** Known from the Azores islands, Pico, São Jorge, and Terceira. Most localities are from Terceira, where it grows always abundantly. It has been found on trunks of trees such as *Cryptomeria* and *Picconia*, shrubs of *Camellia* and *Vaccinium cylindrica*, and on the wood of fences. At the type locality, foliicolous lichens are abundant on *Cryptomeria* needles, belonging to the genera *Byssoloma*, *Fellhanera*, *Porina*, and *Strigula*, and corticolous lichens such as *Micarea alabastrites*, *M. synotheoides*, and *Trapelia corticola*.

**Notes:** This material could be superficially identified with some commonly cited names such as *Fissurina dumastii* Fée [9] and *F. rufula* (Mont.) Staiger. However, morphological and other differences are apparent. Thus, *F. dumastii* has thin labia, apically spinulose paraphyses, and slightly smaller ascospores, whereas *F. rufula* features distinctly prominent lirellae, the upper exposed labia contrasting with the greenish thallus cover of the lirellae. *Fissurina crassilabra* Mont. & Bosch, described from Indonesia, has strongly prominent lirellae with striate labia and gaping disc, whereas *F. insidiosa* C. Knight & Mitten, originally described from New Zealand, differs chiefly in the verrucose thallus [10]. Earlier reports of *F. insidiosa* from the Azores [1,9,11] concern most probably the species here described.

**Specimens examined:** Portugal, Azores, *Faial*, E side of the center of the island, NNW of Flamengos, Jardim Botânico de Pedro Miguel, an area with swamps and mainly *Erica azorica*, with some mixed trees, including *Frangula azorica*. 38°35.00' N, 28°39.36' W, 400 m, 3 June 2016, P. & B. van den Boom 55523 (hb. v.d. Boom); *Pico*, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56562 (hb. v.d. Boom); Paratype: Azores, *São Jorge*, NW of Velas, 3 km NW of Rosais, Reserva Florestal das Sete Fontes, a mixed forest including many *Camellia* shrubs. 38°44.15' N, 28°15.73' W, 415 m, 3 September 2017, P. & B. van den Boom 56990 (hb. v.d. Boom); *Terceira*, NE of Serreta, north trail to Lagoínha, *Cryptomeria japonica* trees (in a forest), *Myrica faya* trees, *Erica*, etc. 38°45.28' N, 27°20.50' W, 500 m, 2 July 2014, P. & B. van den Boom 51685 (hb. v.d. Boom); *Terceira*, N of Angra do Heroísmo, on a secondary very small road to Aqualva, nearby Pico Alto, mainly *Juniperus* shrubs and trees on E exposed slope. 38°44.20' N, 27°12.50' W, 535 m, 19 September 2021, P. & B. van den Boom 60830 (hb. v.d. Boom); *Terceira*, S of Biscoitos, Misterios Negro, south side, W of Pico do Gaspar, on the first part of the trail from the road to NW, a forest with mainly *Cryptomeria* trees. 38°43.84' N, 27°16.65' W, 580 m, 21 September 2021, P. & B. van den Boom 60877 (hb. v.d. Boom); *Terceira*, S of Biscoitos, Misterios Negros, trail PRC 1, starting from Gruta do Natal, in a forest, with mainly *Juniperus* and *Cryptomeria*. 38°44.10' N, 27°16.50' W, 550 m, 21 September 2021, P. & B. van den Boom 60881 (hb. v.d. Boom).

*Fissurina elaiocarpoides* van den Boom, Sipman & Lücking sp. nov. (Figure 3)  
MB849165 A+, C−, M−.



**Figure 3.** *Fissurina elaiocarpoides* (holotype). (A) Habitats, scale = 0.5 mm; (B) Ascospores, scale = 10  $\mu$ m.

**Diagnosis:** Most similar to *Fissurina elaiocarpa* but different in immersed vs. conspicuous and sessile lirellae, olive-yellow vs. reddish-brown excipulum, and slightly shorter and narrower ascospores of  $20\text{--}25 \times 10\text{--}12$  vs.  $21\text{--}28 \times 13\text{--}18$   $\mu\text{m}$ .

**Holotype:** Portugal, Azores, *Faial*, E side of the center of the island, NNW of Flamengos, Jardim Botânico de Pedro Miquel, an area with swamps and mainly *Erica azorica*, with some mixed trees, including *Frangula azorica*.  $38^\circ 35.00'$  N,  $28^\circ 39.36'$  W, 400 m, 3 June 2016, P. & B. van den Boom 55379 (holotype, B; isotype, hb. v.d. Boom).

**Etymology:** The epithet refers to the similarity with *Fissurina elaiocarpa*.

**Thallus** epiperidermal, corticate, smooth to uneven, whitish to pale yellowish brown, up to 0.15 mm thick, matt. **Ascomata** lirelline, rather inconspicuous, erumpent, straight to slightly curved, rarely branched,  $0.3\text{--}1.5 \times 0.15\text{--}0.25$  mm, labia thickened (hemithecioid); excipulum distinct, paraplectenchymatous, olive-yellow, not carbonized, without periphysoids above the hymenium; disc concealed; hymenium  $75\text{--}110$   $\mu\text{m}$ , not interspersed; hypothecium not distinct, hyaline; paraphyses  $(1\text{--})1.5\text{--}2$   $\mu\text{m}$  wide, sometimes slightly widened apically, up to 3  $\mu\text{m}$ , smooth. **Asci** eight-spored,  $75\text{--}100 \times 12\text{--}15$   $\mu\text{m}$ . **Ascospores** muriform,  $20\text{--}25 \times 10\text{--}12$   $\mu\text{m}$ , with thickened septa and rounded to angular lumina and slightly thickened wall, perispore sometimes visible and up to 1.5  $\mu\text{m}$  wide, I+ weakly violet-blue.

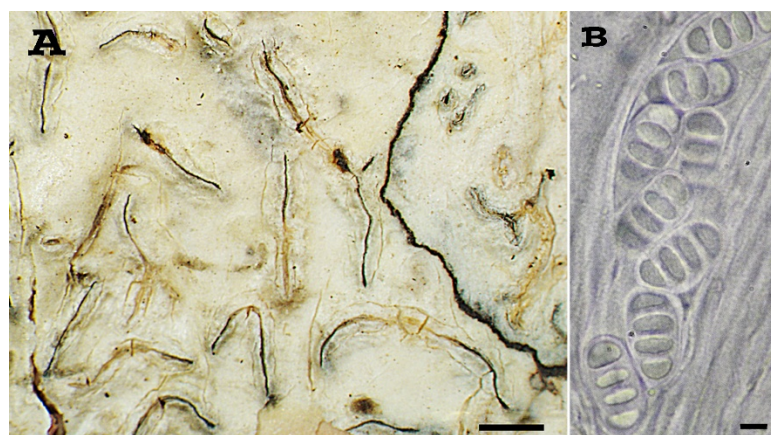
**Chemistry:** K-, C-, P-, UV-, no chemical compounds detected by TLC.

**Distribution and ecology:** Known from the Azores island *Faial*, from the type locality only, where it grows abundantly on the branches of *Frangula azorica* shrubs. At the type locality, no additional lichens have been found, except *Thelotrema lepadinum* (Ach.) Ach. Accompanying species on the same host in other localities are: *Clandestinotrema antoninii*, *Cliomegalaria symmictoides*, *Graphis longissima*, *Hypotrachyna rockii*, and *Phaeographis dendritica*.

**Notes:** This new species belongs in a small group of taxa with muriform ascospores and thickened labia, making the impression of a species of the former genus *Hemithecium*. Although *Fissurina elaiocarpoides* may superficially be identified with commonly cited species such as *F. incrustans* Fée or *F. instabilis* (Nyl.) Nyl., both with muriform ascospores [9], close study shows that these and other superficially similar species have distinct, deviating morphologies and may differ in other details, apart from often different distributions. Thus, *F. incrustans* deviates in the olive-green thallus, the lirellae with thin labia and gaping disc, and the slightly smaller ascospores. *Fissurina instabilis* has an olive-green, uneven to verrucose thallus and whitish labia strongly contrasting with the thallus, and the ascospores are distinctly amyloid. *Fissurina elaiocarpa* (A.W. Archer) A.W. Archer, known from Australia, has an olive-green thallus with splitting cortex, strongly prominent lirellae with thin, orange labia, and broader, I+ distinctly amyloid ascospores [10]. The new species and *F. aff. instabilis* (see below) are the only species of *Fissurina* with muriform ascospores thus far known from Macaronesia.

*Fissurina nigrolabiata* van den Boom, Sipman & Lücking sp. nov. (Figure 4)

MB849166 A+, C-, M-.



**Figure 4.** *Fissurina nigrolabiata* (holotype). (A) Habitus, scale = 1 mm; (B) Ascospores, scale = 5 µm.

**Diagnosis:** Most similar to *Fissurina deficiens* but different in the whitish vs. brownish thallus, the often slightly gaping vs. concealed disc, and the smaller ascospores.

**Holotype:** Portugal, Azores, Pico, SSE of São Roque, on a secondary road on a mountain range, W of Cabeços do Silvado, towards road ER2, near Cabeços do Redondo, on roadside trees and shrubs, including *Erica*, *Ilex*, and *Frangula*, 38°27.98' N, 28°17.62' W, 700 m, 30 August 2017, P. & B. van den Boom 56709 (holotype, B; isotype, hb. v.d. Boom).

**Etymology:** The epithet refers to the habitus of the apothecia, especially the always black-colored labia.

**Thallus** epiperidermal, corticate, smooth, whitish; **Ascomata** lirelline, labia apically distinctly carbonized, apically blackened when seen from above, with short, smooth periphysoids above the hymenium, slightly thickened (almost hemithecioid), 0.3–2 × 0.2–0.6 mm; disc often slightly gaping, appearing blackish, epruinose, in section with blackish epithecium; hymenium not interspersed, 100–120 µm; hypothecium not distinct, hyaline; paraphyses 1–1.5 µm wide, simple, apically not or sometimes slightly widened, smooth. **Asci** eight-spored, mostly one-seriate, 75–90 × 12–20 µm. **Ascospores** three-septate, 14–18 × 7–10 µm, with thickened septa and lens-shaped lumina and slightly thickened wall (bicycle-chain-shaped when young are most probably oil vacuoles), I-negative.

**Chemistry:** K– C–, P–, UV–, no chemical compounds detected by TLC.

**Distribution and ecology:** Known from the Azores islands Faial, Pico, and Terceira. At the type locality, it grows abundantly, on branches of *Frangula azorica* shrubs. At the type locality, additional lichens have been found, such as *Cladonia didyma*, *Clandestinotrema antoninii*, *Coccocarpia palmicola*, *Hypotrachyna endochlora*, *H. taylorensis*, *Mycoblastus alpinus*, and *Pyrenula dermatodes*.

**Notes:** *Fissurina nigrolabiata* is one of several species in the genus with at least partially carbonized labia. Due to the concealed disc and with the apical carbonization visible as a thin black line along the slit, along with the non-amyloid ascospores, the new species is most similar to *F. deficiens* (A.W. Archer) Lücking comb. et stat. nov. [MB849168; basionym: *Graphis nigririmis* (Nyl.) Müll.Arg. var. *deficiens* A.W. Archer, Aust. Syst. Bot. 14: 264 (2001); synonym: *Fissurina nigririmis* var. *deficiens* (A.W. Archer) A.W. Archer, Telopea 11: 71 (2005); comb. inval.]. However, the latter, known from Australia [10], has a more brownish, uneven thallus and larger ascospores (18–22 × 10–14 µm). The young ascospores in *Fissurina nigrolabiata* are sometimes divided into two bicycle-chain-shaped lumina, most probably oil vacuoles.

**Specimens examined:** Portugal, Azores, Terceira, NW of Angra do Heroísmo, Reserva Florestal Viveira da Falca, picnic area, with many mature *Cryptomeria* trees, some *Acer* trees and *Camellia*. 38°42.90' N, 27°16.78' W, 460 m, 28 June 2014, P. & B. van den Boom 51377 (hb. v.d. Boom); Faial, E side of the island, NW of Flamengos, SE slope of the volcano, park Florestal da Falca, a picnic locality with many *Cryptomeria* trees, and small forests of young *Alnus* and *Acer* trees. 38°33.72' N, 28°40.95' W, 500 m, 1 June 2016, P. & B.

van den Boom 55187 (hb. v.d. Boom); *Pico*, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56575 (hb. v.d. Boom); *Pico*, S of Prainha, on a secondary road on the mountain range, Cabeço do Caveiro, *Erica* and *Ilex* shrubs along the road, on *Ilex*. 38°26.08' N, 28°12.20' W, 925 m, 30 August 2017, P. & B. van den Boom 56660 (hb. v.d. Boom); *Pico*, ESE of Madalena, NNW slope of the volcano Pico, SSW of Santa Luzia, N of main road ER3, along a small road from Redondo to Lourenço Nunes, N sloping mixed forest, including *Erica*, *Ilex*, *Laurus*, and *Pinus*. 38°30.12' N, 28°25.18' W, 770 m, 2 September 2017, P. & B. van den Boom 56931 (hb. v.d. Boom); *Santa Maria*, NE of Almagreira, Pico Alto, along a small road to the top (Pico Alto), c. 500 m from the crossing with the main road (ER-1-2), *Erica* at the roadside and along the field. 36°58.57' N, 25°05.18' W, 465 m, 14 September 2019, P. & B. van den Boom 58833 (hb. v.d. Boom); *Terceira*, NW of Angra do Heroísmo, S of road R 5-2, Reserva Florestal, de recreio do Viveira da Falca, a picnic park with mixed trees and shrubs, dominated by *Cryptomeria*. 39°42.74' N, 27°16.87' W, 275 m, 18 September 2021, P. & B. van den Boom 60767 (hb. v.d. Boom); *Terceira*, S of Biscoitos, trail number nine to Rocha do Chambre, among shrubs of *Erica azorica* with some small *Vaccinium* trees. 38°44.87' N, 27°15.32' W, 510 m, 20 September 2021, P. & B. van den Boom 60870 (hb. v.d. Boom).

*Fissurina consentanea* Nyl. (Figure 5) A+, M+, C-.



**Figure 5.** *Fissurina consentanea* (v. d. Boom 56819), habitus. Scale = 1 mm.

**Notes:** *Fissurina consentanea* is usually considered a synonym of *F. triticea* (Nyl.) Staiger [9]. Both agree in the prominent lirellae with thick labia (resembling *Hemithecium*), the three-septate, mid-sized ascospores ( $18\text{--}30 \times 8\text{--}12 \mu\text{m}$ ), and the stictic acid chemistry. However, neotropical material, represented by *F. triticea*, has exposed, yellowish-white labia and the ascospores are weakly amyloid, whereas paleotropical material, represented by *F. consentanea*, has the labia completely covered by thallus and the ascospores are non-amyloid. Specimens from Macaronesia fit the latter and hence should be identified as *F. consentanea*, replacing earlier reports under the names *Graphis triticea* Nyl. [4] and *F. triticea* [5,11].

Selected specimens examined: Portugal, *Madeira*, NW of Funchal, road (ER228) from Ribeira Brava to São Vicente, c. 1.5 km N of Boca da Encumeada, large picnic area with open laurisilva, including very small young trees of 2 cm diameter. 32°45.64' N, 17°01.08' W, 820 m, 30 April 2012, P. & B. van den Boom 47747, 47780 (hb. v.d. Boom). Azores, *Faial*, E side of the island, NW of Flamengos, SE slope of the volcano, park Florestal da Falca, a picnic locality with many *Cryptomeria* trees, and small forests of young *Alnus* and

*Acer* trees. 38°33.72' N, 28°40.95' W, 500 m, 1 June 2016, P. & B. van den Boom 55247 (hb. v.d. Boom); *Pico*, SE of Madalena, on a secondary road on the mountain range, from Capitão to São Mateus, SW slope of the volcano Pico, trees and shrubs in a meadow, including mainly *Erica* and some *Ilex* and *Laurus azorica*. 38°27.54' N, 28°26.20' W, 990 m, 1 September 2017, P. & B. van den Boom 56819 (hb. v.d. Boom); *Terceira*, N of Angra do Heroísmo, on a secondary very small road to Agualva, nearby Pico Alto, mainly *Juniperus* shrubs and trees on E exposed slope. 38°44.20' N, 27°12.50' W, 535 m, 19 September 2021, P. & B. van den Boom 60812, 60816, 60828 (hb. v.d. Boom).

*Fissurina* aff. *dumastii* Fée (Figure 6) A+, C-, M-.



**Figure 6.** *Fissurina* aff. *dumastii* (v. d. Boom 51719), habitus. Scale = 1 mm.

**Notes:** The name *Fissurina dumastii* was mentioned from Terceira [12], without any detail about its morphology. In the literature, descriptions are rather confusing. In [13], the species has immersed lirellae of 1–3 × 0.05–0.1 mm and ascospores of 18–20 × 8–10 μm, but in [9] sessile lirellae (especially visible in Figure 217) of 1–5 × 0.2–0.3 mm and ascospores of 11–18 × 5–6 μm. According to the rather depauperate type material from South America, the species is characterized by mostly immersed lirellae with thin labia (fissurioid) and a somewhat gaping disc, apically spinulose paraphyses, and weakly amyloid ascospores [9]. As a consequence, much of the material identified with that name may not represent that species. Thus far, only two other species have been described with similar morphology but smooth paraphyses, *F. amazonica* M. Cáceres, Aptroot & Lücking from Brazil and *F. coarctata* Makhija & Adaw. from India, both with rather short lirellae [14,15]. We have several specimens that might belong to *F. dumastii*, but most of them are not well developed, with degenerated hymenia. Only one shows properly developed paraphyses and ascospores. It has lirellae 0.5–5 mm long, curved and often branched, a hymenium 90–110 μm high, and ascospores 12–15 × 8–9 μm in size. The original description [16] gives the type as “Habitat in America, ad corticem Cinchonae lanceolatae (Mutis.)”. This indicates that the type is from South America, collected by Mutis; Mutis lived in Colombia, so the type specimen is most probably from Colombia, not USA as indicated in the Index Fungorum.

Specimens examined: Portugal, Azores, *Terceira*, NE of Serreta, on the north trail to Lagoínha, a rather wide, open trail with unidentified small trees (cf. *Ilex perado* ssp. *azorica*) at the edge of a forest. 38°45.15' N, 27°20.17' W, 600 m, 2 July 2014, P. & B. van den Boom 51719 (hb. v.d. Boom).

*Fissurina* aff. *instabilis* (Nyl.) Nyl. (Figure 7) A-, C+, M+.



**Figure 7.** *Fissurina* aff. *instabilis* (v. d. Boom 58322), habitus. Scale = 0.5 mm.

**Notes:** This material comes close to *Fissurina instabilis* in having lirellae with thickened labia (hemithecioid) and muriform ascospores about  $20\text{--}30 \times 9\text{--}12 \mu\text{m}$ . The latter differs, however, in the whitish lirellae contrasting with the olive-green thallus. According to [9], psoromic acid is supposed to be sometimes present in *F. instabilis*; however, this likely refers to two other species with similar morphology and psoromic acid chemistry, namely *F. globulifica* (Nyl.) Staiger and *F. streimannii* (A.W. Archer) A.W. Archer.

Specimens examined: Spain, Canary Islands, *La Palma*, 3.5 km WSW of Los Sauces, Los Tilos, laurisilva, a narrow cleft with path along N facing volcanic outcrops, between a tunnel and mirador.  $28^{\circ}47.10' \text{ N}$ ,  $17^{\circ}48.60' \text{ W}$ , 750 m, 27 October 2012, P. & B. van den Boom 48324 (hb. v.d. Boom). Portugal, *Madeira*, N of Funchal, Ribeiro Frio, E of road (ER103), trail PR10, levada do Furado, in the direction of Portela, laurisilva.  $32^{\circ}44.10' \text{ N}$ ,  $16^{\circ}53.17' \text{ W}$ , 900 m, 8 April 2019, P. & B. van den Boom 58322 (hb. v.d. Boom).

*Fissurina* aff. *hasiana* Makhija & Adawadkar (Figure 8) A+, C-, M-.



**Figure 8.** *Fissurina* aff. *hasiana* (v. d. Boom 56872), habitus. Scale 0.5 mm.



**Notes:** The present material is quite unique in combining hemithecioid lirellae with apical carbonization with three-septate ascospores and a stictic acid chemistry. It is somewhat similar to *Fissurina consentanea*, but differs in the apically carbonized labia. Only two species in the genus share these features: *F. inquinata* C. Knight & Mitt. from New Zealand (synonym: *F. comparilis* var. *nigririmis* Nyl.) and *F. khasiana* Makhija & Adaw. from India. Morphologically, the present material is close to *F. khasiana* in the labia being largely covered by thallus and with a slightly gaping disc, but we have been unable to obtain authentic material of the latter to confirm this identification.

Specimens examined: Portugal, Azores, *Terceira*, NW of Angra do Heroísmo, W of Pico Gordo, Mistério dos Negros (N), a trail from Lagoa do Negro to the west, ±damp *Juniperus brevifolia* forest, with some young *Vaccinium cylindraceum*. 38°44.15' N, 27°16.30' W, 555 m, 28 June 2014, P. & B. van den Boom 51430 (hb. v.d. Boom); *Pico*, S of São Roque, N of road ER3, Lagoa do Capitão, an open area with some trees of *Juniperus brevifolia* at E side near lake. 38°29.20' N, 28°19.09' W, 720 m, 2 September 2017, P. & B. van den Boom 56872 (hb. v.d. Boom).

*Fissurina quadrispora* Kalb A<sup>-</sup>, C<sup>-</sup>, M<sup>+</sup>.

Earlier reports: [9,17].

A distinctive species by the content of psoromic acid, the four-spored asci and the ascospores three-septate, 22–28 × 10–13 µm, known from a single specimen from Madeira so far, and not present among our Macaronesian material.

### 3.2. *Allographa* and *Graphis*

In the checklist of [6], four species currently considered to belong to *Graphis* (including *Allographa*) are listed: *Graphina anguina* from Madeira [18], *Graphis elegans* (Borrer ex Sm.) Ach. from all three island groups, *Graphis lineola* from Madeira [18], given as doubtful, and *Graphis scripta* (L.) Ach. from all three island groups. *Graphis elegans* and *Graphis scripta* are also recorded from the Azores by [4]. The report of *G. anguina* most likely follows the common misinterpretation of this species by European lichenologists during the 20th century. This was corrected by [9] to *Graphis britannica* Staiger and subsequently to *G. inustuloides* Lücking [19]. The report of *G. lineola* by [11] was published with hesitation. Therefore, the species is included below provisionally, awaiting confirmation. This makes it so that only three species of *Graphis* can be considered as known so far from Macaronesia. They are the same species as reported elsewhere in Western Europe and it can be assumed that this reflects the experience of the European lichenologists who visited the islands. However, [20] have shown that the number of *Graphis* species in SW Europe is underestimated. The same might well be the case for Macaronesia, and this was confirmed by the examination of numerous Macaronesian *Graphis* specimens from the herbarium of the first author. Besides *G. elegans* and *G. scripta*, *G. chlorotica*, *G. furcata*, *G. lineola*, *G. longissima*, as well as *Allographa ruiziana* and *A. verminosa* are present. Short descriptions of all taxa are given below.

The identification of *Graphis* species is somewhat tricky because the ascocarps show considerable changes during their development, and well-developed specimens in good condition are needed for easy identification. Initially the ascocarps develop in the host bark. They therefore have a lateral thalline margin when they emerge. This thalline margin may be permanent and cover the lirellae more or less when fully developed, or it may disappear in an early stage. Another age-dependent character is the striation of the exciple. It is seemingly caused by a regeneration of the excipulum, and accordingly still absent in young lirellae. The character of ascospore color can also be misleading. In species of *Graphis* the ascospores are colorless, while in, e.g., *Phaeographis*, the spores assume a pale gray color after a colorless juvenile stage. However, in *Graphis*, overripe and degenerating spores may also become gray. Notably in European samples, the ascocarps tend to contain many such gray, more or less shriveled spores, while colorless, well-developed spores may be scarce. Unfortunately, *Graphis* samples are often without well-developed

ascospores, and for a considerable part of our available material the identification remains provisional. See [21] for more details on *Graphis*.

*Allographa ruiziana* (Fée) Lücking & Kalb (Figure 9) A-, M+, C-.



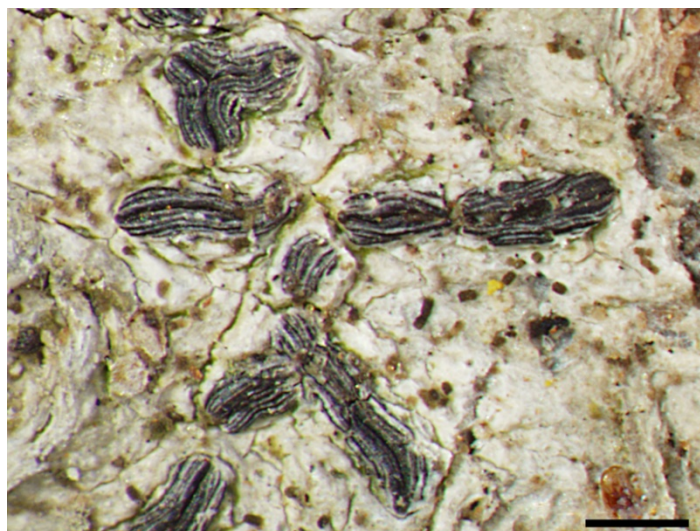
**Figure 9.** *Allographa ruiziana* (v. d. Boom 47813), habitus. Scale = 0.5 mm.

Thallus without lichen substances; ascocarps sessile, short, without thalline margin, with entire, completely carbonized excipulum, with concealed disc, and often with a weakly pruinose zone along the slit; hymenium clear; ascospores muriform, ca. eight per ascus, ca.  $30 \times 15 \mu\text{m}$ , ca.  $8 \times 2\text{--}3$  locules.

**Notes:** New to Macaronesia. A widespread, characteristic species in the tropics, also known from oceanic Europe.

Specimen examined: Portugal, *Madeira*, NW of Funchal, road (ER228) from Ribeira Brava to São Vicente, near mirador of Boca da Encumeada, on the first part of the trail '1.3' from 'Vereda da Encumeada', to Pico Ruivo, along laurisilva.  $32^\circ 45.20' \text{N}$ ,  $17^\circ 01.08' \text{W}$ , 1045 m, 30 April 2012, P. & B. van den Boom 47813 (hb. v.d. Boom).

*Allographa verminosa* (Müll. Arg.) Lücking & Kalb (Figure 10) A+, M+, C-.



**Figure 10.** *Allographa verminosa* (v. d. Boom 47626), habitus. Scale = 1 mm.

Thallus rather thick and chalky, with norstictic acid; ascocarps erumpent, with lateral thalline margin, with rather soon striate, laterally carbonized excipulum, and with concealed disc; hymenium clear; ascospores bacillar, ca.  $55\text{--}70 \times 9\text{--}12 \mu\text{m}$ , 12–16-loculate, with lenticular lumina.

**Notes:** The Azores specimens fit *Allographa verminosa* as reported from Sintra [20]. The original description of *Graphis verminosa* Müll. Arg. [22] mentions lirellae 1–5 mm long, 0.5 mm wide, “subsimples et subrectae”, i.e., mostly unbranched and rather straight (confirmed by checking the lectotype: <https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.bm001106315> (accessed 2 December 2022)); spores “8nae,  $80\text{--}150 \times 7\text{--}10 \mu\text{m}$ , 25–38-loc., vermiformes”. The Macaronesian (and mainland Portugal) material deviates because the ascospores are much shorter and slightly thicker and it might actually represent an undescribed taxon. The material here identified as *Allographa verminosa* has so far been confused with *G. elegans*. Both have striate lirellae and norstictic acid. The two species can be distinguished macroscopically by the emergent ascocarps with well-developed thalline margins in the first species, and the sessile ascocarps without thalline margins in *G. elegans*. Microscopically *A. verminosa* has slender ascospores ( $9\text{--}12 \mu\text{m}$  wide) with lenticular locules and thin walls, and *G. elegans* has thicker ascospores (thick-walled,  $15\text{--}17 \mu\text{m}$  wide) with rounded locules and thick walls. However, poorly developed specimens with poorly developed ascocarps and no ripe ascospores may be difficult to recognize.

Specimens examined: Portugal, *Madeira*, NE of Funchal, Santo da Serra, center of the village, a botanical garden ‘Quinta do Santo da Serra’.  $32^{\circ}43.51' \text{ N}$ ,  $16^{\circ}49.12' \text{ W}$ , 700 m, 28 April 2012, P. & B. van den Boom 47626 (hb. v.d. Boom). Azores, *Terceira*, W of Praia da Vitória, S of São Brás, S of Baldio, a picnic area, the starting point for the trail to Biscoito da Fontinhas, mixed trees, including *Myrica faya*.  $38^{\circ}44.90' \text{ N}$ ,  $27^{\circ}07.83' \text{ W}$ , 195 m, 29 June 2014, P. & B. van den Boom 51486 (hb. v.d. Boom); *Santa Maria*, NE side of Vila Do Porto, Reserva Florestal de Valverde, mixed trees and shrubs, dominated by *Thuja* trees.  $36^{\circ}57.52' \text{ N}$ ,  $25^{\circ}08.06' \text{ W}$ , 135 m, 12 September 2019, P. & B. van den Boom 58650 (hb. v.d. Boom); *Graciosa*, SE of Guadelupe, a small road to the east, between Barro Branco and Feireira, a trail along a forest and fields.  $39^{\circ}03.13' \text{ N}$ ,  $27^{\circ}59.69' \text{ W}$ , 120 m, 15 September 2021, P. & B. van den Boom 60691 (hb. v.d. Boom).

*Graphis chlorotica* A. Massal. (Figure 11) A+, M–, C–.  
Published by [2] as *Graphis longula* Kremp.



**Figure 11.** *Graphis chlorotica* (v. d. Boom 46752), habitus. Scale = 0.5 mm.

Thallus without lichen substances; ascocarps erumpent with lateral thalline margin, with striate, apically carbonized excipulum, and with a concealed disc; hymenium clear; ascospores bacillar, ca.  $45 \times 12 \mu\text{m}$ , 10-loculate, with lenticular lumina and a thin outer wall.

**Notes:** This is the first report from Macaronesia of this pantropical species [21]. The specimen deviates slightly because the striae on the excipulum are scarce and the central parts of the lirellae are not swollen and rather scarcely striate.

Specimen examined: Portugal, Azores, *São Miguel*, NE of Furnas, on the trail from the main road near Pico do Salto do Cavalo to Sebastião Alves, an open grassy area (rather wet soil) with some small groups of *Cryptomeria* trees and one solitary *Acer* tree.  $37^{\circ}47.50' \text{ N}$ ,  $25^{\circ}16.50' \text{ W}$ , 875 m, 29 October 2011, P. & B. van den Boom 46752 (hb. v.d. Boom).

*Graphis elegans* (Borrer ex Sm.) Ach. (Figure 12) A+, M+, C+.



**Figure 12.** *Graphis elegans* (v. d. Boom 46072), habitus. Scale = 0.5 mm.

Thallus with norstictic acid; ascocarps sessile, without thalline margin except when young, about 0.3 mm wide without thalline margin, with entire or in older lirellae striate, laterally to (almost) completely carbonized excipulum, and with a concealed disc; hymenium clear; ascospores bacillar, ca.  $60\text{--}75 \times 15\text{--}17 \mu\text{m}$ , ca. 12-loculate, with thick lateral wall and rounded lumina.

**Notes:** For earlier reports see [6,11].

The presence of norstictic acid is best demonstrated by adding K to a (thick) section. Under the microscope, yellow clouds will develop, which condensate into numerous small red crystals. A K-reaction directly on the thallus often remains uncertain.

Specimens examined: Portugal, Azores, *São Miguel*, NW of Ponta Delgada, road to Sete Cidades, SE of the village, near view points between Lagoa de Santiago and Lagoa Verde. 37°51.10' N, 25°46.00' W, 440 m, 25 October 2011, P. & B. van den Boom 46542 (hb. v.d. Boom); *Terceira*, WNW of Angra do Heroísmo, NNE of Santa Bárbara, Cerrado das Sete, a picnic area with mature *Cryptomeria* trees. 38°42.60' N, 27°19.52' W, 460 m, 1 July 2014, P. & B. van den Boom 51644 (hb. v.d. Boom); *Pico*, SSE of São Roque, on a secondary road on the mountain range, W of Cabeços do Silvado, towards road ER2, near Cabeços do Redondo, roadside trees and shrubs, including *Erica*, *Ilex*, and *Frangula*. 38°27.98' N, 28°17.62' W, 700 m, 30 August 2017, P. & B. van den Boom 56705, 56711 (hb. v.d. Boom); *Madeira*, N of Funchal, along the road (ER103) from Poiso to Ribeiro Frio, 500 m S of Ribeiro Frio, a roadside picnic area, on the wood of a bench and some trees. 32°44.03' N, 16°53.33' W, 910 m, 27 April 2012, P. & B. van den Boom 47519 (hb. v.d. Boom). Spain, Canary Islands, *La Gomera*, Garajonay N.P., c. 5 km SSW of Hermigua, along road TF-711, mirador de el Rejo, a wall of acidic stones, horizontal surface, steep N exposed outcrops and a *Myrica faya* tree. 28°07.53' N, 17°12.44' W, 1190 m, 2 September 2011, P. & B. van den Boom 46072 (hb. v.d. Boom); *Tenerife*, Las Montanas de Anaga, road TF145 from Taborno to Carboneras, near Montana Cruz de Taborno, a trail to the west, to Batan, in laurisilva. 28°32.39' N, 16°16.70' W, 570 m, 25 February 2011, P. & B. van den Boom 45521 (hb. v.d. Boom).

*Graphis furcata* Fée (Figure 13) A+, M-, C-.



**Figure 13.** *Graphis furcata* (v. d. Boom 56590), habitus. Scale = 1 mm.

Thallus without lichen substances; ascocarps erumpent, about 0.2 mm wide including the thalline margin, slightly sinuous, with gradually raising, lateral thalline margin and the exposed part of the exciple narrow, black, with entire, laterally carbonized excipulum, and with a concealed disc; hymenium clear; ascospores bacillar, ca. eight per ascus,  $25 \times 8 \mu\text{m}$ , 6–8-loculate, with lenticular lumina.

**Notes:** A widespread tropical species, which is reported here for the first time from Macaronesia.

Specimens examined: Portugal, Azores, *Faial*, E slope of Caldeira vulcan, 800 m, July 1986, A. Aptroot 16740 [B 60 0177734]; *São Miguel*, NW of Ponta Delgada, on the road to Sete Cidades, SE of the village, near view points between Lagoa de Santiago and Lagoa Verde. 37°51.10' N, 25°46.00' W, 440 m, 25 October 2011, P. & B. van den Boom 46534 (hb. v.d. Boom); *São Miguel*, NE of Furnas, a trail from the main road near Pico do Salto do

Cavalo to Sebastião Alves, an open grassy area (rather wet soil) P. & B. van den Boom 46761 (hb. v.d. Boom); Pico, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56590 (hb. v.d. Boom).

***Graphis inustuloides* Lücking**

(syn. *Graphis britannica* Auct., *Graphis anguina* Auct.) A-, M+, C-.

Thallus without lichen substances; ascocarps erumpent, with persistent thalline margin, with entire, laterally carbonized excipulum, often with exposed, gray disc; hymenium clear; ascospores muriform, ca. eight per ascus, 25–50 × 12–16 µm, 8–12 × 2–3-loculate, with rounded lumina.

**Notes:** Reported in Macaronesia, so far only from Madeira, by [6]. This species is apparently uncommon, as we have not seen any Macaronesian material. See also [9], sub *Graphis britannica*.

***Graphis lineola* Ach. A-, M+, C-.**

Thallus without lichen substances; ascocarps erumpent, with continuous thalline margin, with entire, laterally carbonized excipulum, and with a concealed disc; hymenium inspersed; ascospores bacillar, ca. eight per ascus, 25 × 8 µm, 6–8-loculate, with lentiform lumina.

**Notes:** The earliest report is by Tavares [18], as doubtful, cited by [5,6]. Recently it was reported from mainland Portugal [20]. As currently understood [21], *G. lineola* resembles *G. scripta* and differs by an inspersed hymenium. No such hymenium was present in the Macaronesian specimens available to us.

***Graphis longissima* Makhija & Adaw. A+, M-, C-.**

Published by [23].

***Graphis scripta* (L.) Ach. s.l. (Figure 14) A+, M+, C+.**



**Figure 14.** *Graphis scripta* (v. d. Boom 47622), habitus. Scale = 0.5 mm.

Thallus without lichen substances; ascocarps erumpent, with basal to lateral thalline margin, with entire, laterally carbonized excipulum, and with exposed and pruinose disc in older lirellae; hymenium clear; ascospores bacillar, ca. 25–45(–55) × 6–11 µm, 8–9-septate, with lenticular lumina.

**Notes:** Earlier reports are by [6,11]. The material fits well the European mainland specimens.

Specimens examined: Spain, Canary Islands, *Gran Canaria*, W of Las Palmas, SSW of Moya, Los Tilos, a small Laurisilva forest with boulders and steep outcrops. 28°05.2' N, 15°35.7' W, 550 m, 10 February 2005, P. & B. van den Boom 34468 (hb. v.d. Boom); *La Palma*, 3.5 km WSW of Los Sauces, Los Tilos, laurisilva, a narrow cleft with a path along N facing volcanic outcrops, between a tunnel and mirador. 28°47.10' N, 17°48.60' W, 750 m, 27 October 2012, P. & B. van den Boom 48333 (hb. v.d. Boom). Portugal, *Madeira*: NE of Funchal, Santo da Serra, center of the village, a botanical garden 'Quinta do Santo da Serra'. 32°43.51' N, 16°49.12' W, 700 m, 28 April 2012, P. & B. van den Boom 47622 (hb. v.d. Boom). Azores, *Faial*, W side of the island, Praia do Norte, centre, in front of a restaurant, a solitary, unidentified tree along the road. 38°35.97' N, 28°45.66' W, 270 m, 31 May 2016, P. & B. van den Boom 55122 (hb. v.d. Boom); *Faial*, E side of the island, NW of Flamengos, SE slope of the volcano, park Florestal da Falca, a picnic locality with many *Cryptomeria* trees, and small forests of young *Alnus* and *Acer* trees. 38°33.72' N, 28°40.95' W, 500 m, 1 June 2016, P. & B. van den Boom 55196 (hb. v.d. Boom); *Faial*, E side of the island, Horta, N side of the village, Alagoa municipal park, mixed trees, including some mature. 38°32.67' N, 28°37.17' W, 25 m, 2 June 2016, P. & B. van den Boom 55280 (hb. v.d. Boom).

### 3.3. List of Further Graphidaceae Known from Macaronesia, with New Records and *Topeliopsis juniperina* sp. nov.

***Anomalographis madeirensis*** (Tav.) Kalb A+, M+, C+.

Earlier reports: [6,17,18,24].

New records: Spain, Canary Islands, *Tenerife*, Agua García. Alt. 800 m. Laurisilva. 29 September 1992, C. Hernández Padrón & P.L. Pérez de Paz 2241 [B 60 0073345]. Portugal, Azores, *Graciosa*, WNW of Luz, margin of the volcano crater, near a cave, a view point, with mixed trees and steep shaded outcrops. 39°01.77' N, 27°58.83' W, 230 m, 14 September 2021, P. & B. van den Boom 60641 (hb. v.d. Boom).

***Clandestinotrema antoninii*** (Purvis & P. James) Rivas Platas Lucking & Lumbsch A+, C-, M-.

Earlier reports: [6,16,25–27].

Selected new records: Portugal, *Madeira*, NW of Funchal, road (ER228) from Ribeira Brava to São Vicente, c. 1.5 km N of Boca da Encumeada, a large picnic area with open laurisilva, including very small young trees of 2 cm diameter. 32°45.64' N, 17°01.08' W, 820 m, 30 April 2012, P. & B. van den Boom 47750, 57760, 47782 (hb. v.d. Boom). Azores, *Terceira*, NW of Angra do Heroísmo, Reserva Florestal Viveira da Falca, a picnic area, with many mature *Cryptomeria* trees, some *Acer* trees, and one *Camellia*. 38°42.90' N, 27°16.78' W, 460 m, 28 June 2014, P. & B. van den Boom 51338 (hb. v.d. Boom); *Terceira*, NW of Angra do Heroísmo, W of Pico Gordo, Mistério dos Negros (N), a trail from Lagoa do Negro to the west, ±damp *Juniperus brevifolia* forest, with some young *Vaccinium cylindraceum*. 38°44.15' N, 27°16.30' W, 555 m, 28 June 2014, P. & B. van den Boom 51442 (hb. v.d. Boom); *Terceira*, NE of Serreta, the north trail to Lagoínha, *Cryptomeria japonica* trees (in the forest), *Myrica faya* trees, *Erica*, etc. 38°45.28' N, 27°20.50' W, 500 m, 2 July 2014, P. & B. van den Boom 51690, 51702 (hb. v.d. Boom); *Terceira*, N of Angra do Heroísmo, E of Bagacina, Algar do Carvão, a hilly area near a cave, with shrubs, including *Erica*. 38°43.69' N, 27°12.98' W, 485 m, 3 July 2014, P. & B. van den Boom 51835 (hb. v.d. Boom); *Faial*, N side of the center of the island, along road ER2, Reserva Florestal do Cabouco Velho, a picnic park with mixed trees, including some shrubs. 38°35.93' N, 28°40.91' W, 520 m, 3 June 2016, P. & B. van den Boom 55310 (hb. v.d. Boom); *Faial*, E side of the center of the island, NNW of Flamengos, Jardim Botânico de Pedro Miguel, an area with swamps and mainly *Erica azorica*, with some mixed trees, including *Frangula azorica*. 38°35.00' N, 28°39.36' W, 400 m, 3 June 2016, P. & B. van den Boom 55355 (hb. v.d. Boom); *Pico*, ESE of São Roque, near Prainha de Cima, Reserva Florestal da Prainha, a picnic area with mixed shrubs and trees. 38°29.32' N, 28°14.70' W, 230 m, 29 August 2017, P. & B. van den Boom 56592, 56606 (hb. v.d. Boom); *Pico*, SE of São Roque, SW of Prainha, on a secondary road on the mountain range, Cabeço da Cheira, *Erica* and *Juniperus* shrubs and trees in a

meadow. 38°27.82' N, 28°14.01' W, 500 m, 30 August 2017, P. & B. van den Boom 56631 (hb. v.d. Boom); *Pico*, S of Prainha, on a secondary road on the mountain range, Cabeço do Caveiro, *Erica* and *Ilex* shrubs along road. 38°26.08' N, 28°12.20' W, 925 m, 30 August 2017, P. & B. van den Boom 56661 (hb. v.d. Boom). *São Jorge*, N of Calheta, along road ER1 (E side), to Norte Pequeno, E of Pico Meio, c. 500 m S of crossing to Silveira, a meadow with some *Erica* shrubs, and *Laurus azorica* at the edge of a small forest. 38°37.91' N, 27°59.75' W, 470 m, 6 September 2017, P. & B. van den Boom 57125, (hb. v.d. Boom); *São Jorge*, N of Calheta, along a small road, E crossing with road ER1, E of Pico Meio, on the road to Silveira, a group of *Cryptomeria* trees. 38°37.78' N, 27°59.02' W, 455 m, 6 September 2017, P. & B. van den Boom 57144 (hb. v.d. Boom); *Santa Maria*, NE of Almagreira, Pico Alto, along a small road to the top (Pico Alto), c. 500 m from a crossing with the main road (ER-1-2), *Erica* at the roadside and along the field. 36°58.57' N, 25°05.18' W, 465 m, 14 September 2019, P. & B. van den Boom 58825, 58829, 58834 (hb. v.d. Boom). *Terceira*, NW of Angra do Heroísmo, S of road R 5-2, Reserva Florestal, de recreio do Viveira da Falca, a picnic park with mixed trees and shrubs, dominated by *Cryptomeria*. 39°42.74' N, 27°16.87' W, 275 m, 18 September 2021, P. & B. van den Boom 60774 (hb. v.d. Boom); *Terceira*, N of Angra do Heroísmo, on a secondary very small road to Agualva, nearby Pico Alto, mainly *Juniperus* shrubs and trees on E exposed slope. 38°44.20' N, 27°12.50' W, 535 m, 19 September 2021, P. & B. van den Boom 60822 (hb. v.d. Boom).

<i>Crutarndina petractoides</i> (P.M. Jørg. & Brodo) Parnmen, Lücking & Lumbsch (syn. <i>Thelotrema petractoides</i> P.M. Jørg. & Brodo)	A−, C−, M+
Earlier report: [6,7,20,27], also as <i>Thelotrema subtile</i> Tuck.	
<i>Diploschistes actinostomus</i> (Pers. ex Ach.) Zahlbr.	A+, C+, M+
Earlier reports: [4,6,11].	
<i>Diploschistes caesioplumbeus</i> (Nyl.) Vain.	A+, C+, M+
Earlier reports: [4,6,11].	
<i>Diploschistes candidissimus</i> (Kremp.) Zahlbr.	A−, C+, M−
Earlier reports: [4,6].	
<i>Diploschistes diacapsis</i> (Ach.) Lumbsch	A+, C+, M+
Earlier reports: [4,6,11].	
<i>Diploschistes euganeus</i> (A. Massal.) J. Steiner	A+, C+, M−
Earlier reports: [4].	
<i>Diploschistes gypsaceus</i> (Ach.) Zahlbr.	A+, C+, M+
Earlier reports: [4,6,11].	
<i>Diploschistes muscorum</i> (Scop.) R. Sant.	A+, C+, M−
Earlier reports: [4,6,11].	
<i>Diploschistes scruposus</i> (Schreb.) Norman	A+, C+, M+
Earlier reports: [4,6,11].	
<i>Glyphis cicatricosa</i> Ach.	A+, C+, M−
Earlier reports: [2,4,6,11].	

New records: Portugal, Azores, *Pico*, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56586 (hb. v.d. Boom); *São Jorge*, NE of Calheta, Reserva Florestal da Silveira, a picnic area, a small open forest with mixed trees and shrubs, including *Pinus*, *Cryptomeria*, tree ferns, and *Camellia* shrubs. 38°36.79' N, 27°58.62' W, 290 m, 5 September 2017, P. & B. van den Boom 57083, 57085 (hb. v.d. Boom).

*Leucodecton isidioides* (Borrer) Lücking & Breuss A+, C−, M+.  
(syn. *Thelotrema isidioides* (Borrer) R. Sant.).  
Earlier reports: [6,7,11,26].

New records: Portugal, Azores, *Pico*, SE of São Roque, N of a secondary road on the mountain range, Caminho dos Burros, a trail from south to north, near Cabeços do Misténo, *Erica* and *Ilex* shrubs and trees in an open area. 38°27.86' N, 28°16.53' W, 780 m,



30 August 2017, P. & B. van den Boom 57224 (hb. v.d. Boom); *Pico*, S of São Roque, N of road ER3, Lagoa do Capitão, an open area with some trees of *Juniperus brevifolia* at E side near lake. 38°29.20' N, 28°19.09' W, 720 m, 2 September 2017, P. & B. van den Boom 56879 (hb. v.d. Boom).

***Leucodecton sordidescens*** (Fée) Lücking A-, C-, M+.

(syn. *Myriotrema sordidescens* (Fée) Kalb).

Earlier report: [17]. The species is not accepted for Macaronesia by [7] and the records may need revision.

***Ocellularia pauciseptata*** (Purvis & P. James) Aptroot A+, C-, M-.

(syn. *Thelotrema perforatum* Leight. var. *pauciseptatum* Purvis & P. James).

Earlier reports: [4,7,11,26].

New record: Portugal, Azores, *Pico*, SE of São Roque, N of a secondary road on the mountain range, Caminho dos Burros, a trail from south to north, near Cabeços do Misténo, *Erica* and *Ilex* shrubs and trees in an open area. 38°27.86' N, 28°16.53' W, 780 m, 30 August 2017, P. & B. van den Boom 56692 (hb. v.d. Boom).

***Phaeographis dendritica*** (Ach.) Müll. Arg. A+, C+, M+.

Earlier reports: [6,11].

***Phaeographis inusta*** (Ach.) Müll. Arg. A+, C-, M-.

Earlier reports: [6,11].

New records: Portugal, Azores, *Pico*, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56566, 56583, 56587 (hb. v.d. Boom).

***Phaeographis smithii*** (Leight.) B. de Lesd. A+, C-, M+.

Earlier reports: [11,28].

***Thelotrema lacteum*** Kremp. A-, C+, M-.

Earlier reports: [7,29] also as *Thelotrema rockii*.

***Thelotrema laurisilvae*** Lücking & Breuss A+, C-, M+.

Earlier report: [7].

New records: Portugal, Azores, *Pico*, E of Madalena, Parque Florestal da Quinta das Rosas, a botanical garden with mixed shrubs and trees, including some exotic trees. 38°31.38' N, 28°29.38' W, 150 m, 29 August 2017, P. & B. van den Boom 56574, 56588 (hb. v.d. Boom); *São Jorge*, NW of Velas, 3 km NW of Rosais, Reserva Florestal das Sete Fontes, a mixed forest including many *Camellia* shrubs. 38°44.18' N, 28°15.64' W, 410 m, 7 September 2017, P. & B. van den Boom 57192 (hb. v.d. Boom).

***Thelotrema lepadinum*** (Ach.) Ach. A+, M+, C+.

Earlier reports: [7,11,17,30,31], also as var. *maderense* Stein.

New records: Portugal, Azores, *Pico*, SE of São Roque, SW of Prainha, a secondary road on the mountain range, Cabeço da Cheira, *Erica* and *Juniperus* shrubs and trees in a meadow. 38°27.82' N, 28°14.01' W, 500 m, 30 August 2017, P. & B. van den Boom 56633 (hb. v.d. Boom); *Pico*, SSE of São Roque, on a secondary road on the mountain range, W of Cabeços do Silvado, towards road ER2, near Cabeços do Redondo, roadside trees and shrubs, including *Erica*, *Ilex*, and *Frangula*. 38°27.98' N, 28°17.62' W, 700 m, 30 August 2017, P. & B. van den Boom 56706 (hb. v.d. Boom); *Pico*, WSW of Piedade, 1 km W of Ribeirinha, near mirador, along road ER1, roadside trees, including *Cryptomeria* and *Metrosideros excelsa*. 38°26.51' N, 28°06.27' W, 380 m, 31 August 2017, P. & B. van den Boom 56729 (hb. v.d. Boom); *Graciosa*, WNW of Luz, inside a volcano crater, Centro de Visitantes da Furna do Enxofre, at the end of the road, trees and shrubs on a slope. 39°01.50' N, 27°58.33' W, 120 m, 13 September 2021, P. & B. van den Boom 60555 (hb. v.d. Boom); *Terceira*, S of Biscoitos, trail number nine to Rocha do Chambre, among shrubs of *Erica azorica* with some small *Vaccinium* trees. 38°44.87' N, 27°15.32' W, 510 m, 20 September 2021, P. & B. van den Boom 60854 (hb. v.d. Boom).

***Thelotrema lueckingii*** Breuss A-, C-, M+.

Earlier reports: [32].

This species was published after the key of [7]. It is said to be similar to *T. lepadinum* from which it differs by a yellow, K+ red medulla.

*Thelotrema macrosporum* P.M. Jørg. & P. James A-, C+, M+.

Earlier reports: [7,20,25], also as *Thelotrema monosporum* Nyl.

*Thelotrema subtile* Tuck.

Earlier reports: [11]. This species was not accepted by [7] and the records may need revision.

*Thelotrema suecicum* (Magn.) P. James A-, C-, M+.

Earlier report: [7], as *T. aff. suecicum*.

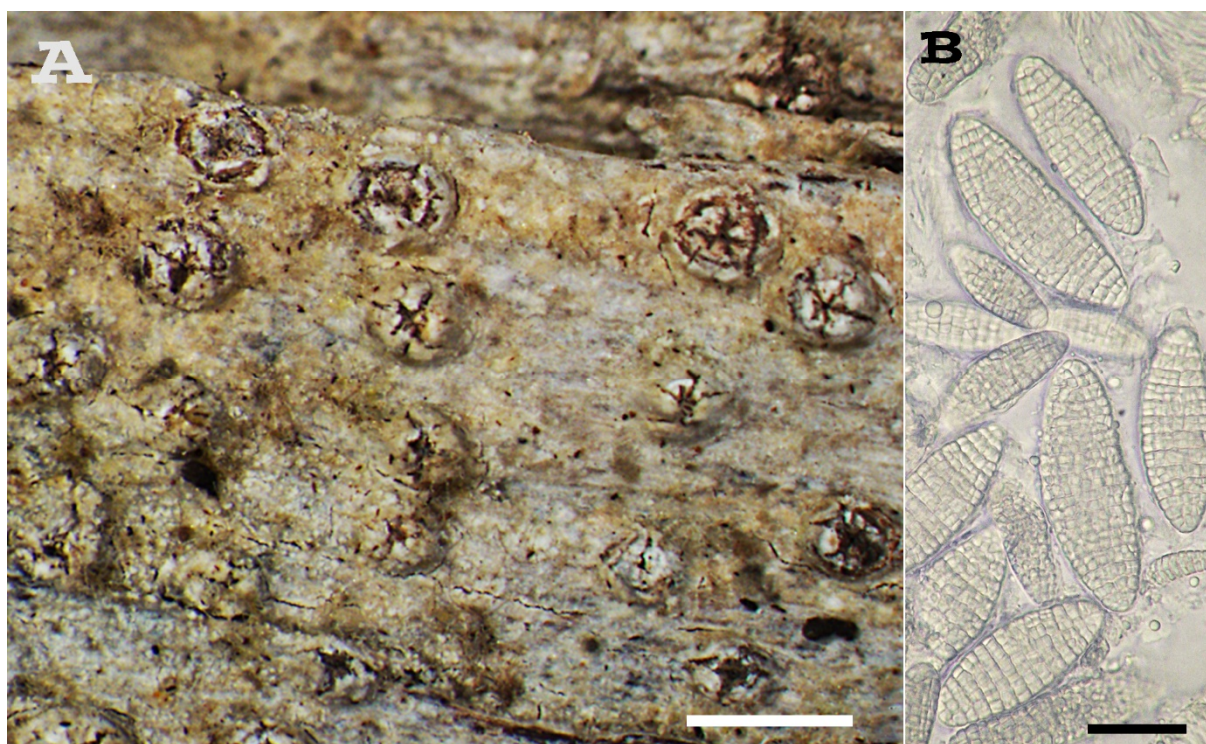
*Topeliopsis azorica* (P. James & Purvis) Coppins & Aptroot A+, C-, M-.

Earlier reports: [6,11,33,34] also as *Ramonia azorica* P. James & Purvis.

New record: Portugal, Azores, Pico, SE of Madalena, on a secondary road on the mountain range, from Capitão to São Mateus, SW slope of volcano Pico, trees and shrubs in a meadow, including mainly *Erica* and some *Ilex* and *Laurus azorica*. 38°27.54' N, 28°26.20' W, 990 m, 1 September 2017, P. & B. van den Boom 56821 (hb. v.d. Boom).

*Topeliopsis juniperina* van den Boom & Sipman sp. nov. (Figure 15).

MB849252 A+, C-, M-.



**Figure 15.** *Topeliopsis juniperina* (holotype). (A) Habitus, scale = 1 mm; (B) Ascospores, scale = 20  $\mu$ m.

**Diagnose:** Similar to *Topeliopsis azorica* but with stictic acid and 2–4 spores per ascus measuring ca. 60  $\times$  20  $\mu$ m.

**Holotype:** Portugal, Azores, Pico, S of São Roque, N of road ER3, Lagoa do Capitão, an open area with some trees of *Juniperus brevifolia* at E side near a lake. 38°29.20' N, 28°19.09' W, 720 m, 2 September 2017, P. & B. van den Boom 56871 (B holotype, hb. v.d. Boom isotype).

**Thallus** greenish gray, epiphloeodic on bark of *Juniperus*, several cm in diameter, ca. 50  $\mu$ m thick, with prosoplectenchymatic cortex 10 thick, and *Trentepohlia*-type photobiont with roundish cells ca. 10  $\mu$ m in diameter. **Ascocarps** 0.5–1.0 mm in diameter, visible as closed rings of ca. 4–8 irregular and fragile teeth raising about 0.4 mm above the thallus, at age abraded and showing up to four rings of abraded excipular teeth; excipulum lateral, gray, with periphyses c. 10  $\mu$ m long, conglutinated and forming a palissadic layer in the

inside of the excipulum; hymenium 200 µm high, clear. **Ascospores** colorless, muriform, 2–4 per ascus, 57–53 × 17–25 µm, with ca. 16–18 × 4–5 locules, I-negative, with thin septa. No pycnidia detected.

**Chemistry:** stictic, constictic acids by TLC.

**Distribution and ecology:** Known from the Azores island Pico, from the type locality only, where it grows abundantly, on branches of *Frangula azorica* shrubs. At the type locality, a lot of additional, well-developed lichens have been found on the same host, such as *Cladonia stereoclada*, *Clandestinotrema antoninii*, *Mycoblastus alpinus*, and *Sphaerophorus globosus*.

**Notes:** This species differs from the other *Topeliopsis* species in Macaronesia, *T. azorica*, by the presence in the thallus of stictic acid instead of no lichen substance, and the smaller ascospores about 60 × 20 µm, 2–4 per ascus instead of 100–140 × 27–45 µm, single in the ascus. The chemistry and the spores distinguish it also from all other described *Topeliopsis* species [5,16,18,26,32,34–37].

This new *Topeliopsis* is easily overlooked for *T. azorica*, especially in the field. Therefore, differences about ascospores and chemistry should be checked. *T. azorica* is known from the same island (Pico) as the new species.

***Xalocoa ocellata*** (Fr.) E. Kraichak, R. Lücking & Lumbsch A+, C+, M-.

Earlier reports: [6,11] as *Diploschistes ocellatus*.

**Excluded from the family** [38]:

*Conotrema harmandii* (Pit.) Gilenstam (*Thelotrema harmandii* Pit.) A-, C+, M-.

Earlier reports: [6,18,27].

*Ingvariella bispora* (Bagl.) Guderley & Lumbsch (*Diploschistes bisporus* (Bagl.) J. Steiner A-, C+, M-.

Earlier reports: [4,6].

### 3.4. Key to Graphidaceae in Macaronesia

1	Thallus corticolous	2
1'	Thallus saxicolous, terricolous, or lichenicolous	24
2	Ascomata apothecium-like, rounded with single discs	3
2'	Ascomata pseudostromatic or lirelliform	5
3	Ascocarps with one or more circles of excipular teeth covering the disc; ascospores muriform with thin septa ( <i>Topeliopsis</i> )	4
3'	Ascocarps with open discs or when excipulum covering the disc, this not divided into teeth; ascospores mostly bacillar, when muriform with thick septa and rounded locules ( <i>Thelotremoid</i> species)	See key in [7]
4	Ascospores one per ascus, 100–140 µm long; no lichen substances	<i>Topeliopsis azorica</i>
4'	Ascospores 2–4 per ascus, ca. 60–70 × 25 µm long; stictic acid	<i>Topeliopsis juniperina</i>
5	Ascocarps rounded, pseudostromatic, with several discs	<i>Glyphis cicatricosa</i>
5'	Ascocarps elongate, lirelliform, often without visible disc	6
6	Ascomata fissurinoid (open by elongate cracks in thallus) or hemithecioid, with non-amyloid or weakly amyloid, hyaline ascospores ( <i>Fissurina</i> )	7
6'	Ascomata different, with amyloid or brown ascospores	14
7	Ascospores muriform; no chemical compounds	8
7'	Ascospores three-septate; stictic or psoromic acid or no chemical compounds	9
8	Ascospores 20–25 × 10–12 µm	<i>Fissurina elaiocarporoides</i>
8'	Ascospores 17–24 × 10–15 µm	<i>Fissurina</i> aff. <i>instabilis</i>
9	Labia prominent, robust, thickened; stictic acid complex	10
9'	Labia semiimmersed to erumpent, slightly raised; psoromic acid or no chemical compounds	11
10	Labia lips often wide open	<i>Fissurina consentana</i>
10'	Labia lips slightly open	<i>Fissurina</i> aff. <i>khasiana</i>

11	Psoromic acid; ascospores four per ascus	<i>Fissurina quadrispora</i>
11'	No substances; ascospores eight per ascus	12
12	Labia apically carbonized, blackened when seen from above	<i>Fissurina nigrolabiata</i>
12'	Labia not carbonized	13
13	Labia elongate, 1–5 mm, 0.2–0.3 mm wide, often strongly curved	<i>Fissurina</i> aff. <i>dumastii</i>
13'	Labia clearly shorter, 1.5–2.5 mm, 0.2–0.5 wide, straight to slightly curved	<i>Fissurina azorica</i>
14	Ascospores hyaline ( <i>Allographa</i> , <i>Graphis</i> )	15
14'	Ascospores gray-brown when mature ( <i>Phaeographis</i> )	22
15	Hymenium inspersed with dense oil-like droplets; ascospores bacillar	<i>G. lineola</i>
15'	Hymenium clear; ascospores bacillar or muriform	16
16	Ascospores muriform, ca. 8–12 × 2–3 locules	17
16'	Ascospores only transversely septate	18
17	Ascomata sessile, short, and without thallus cover; disc concealed	<i>Allographa ruiziana</i>
17'	Ascomata semi-immersed in the thallus and laterally with a continuous thalline margin; disc often exposed, gray	<i>Graphis inustuloides</i>
18	Labia entire, visible as a single black line; no chemical compounds	19
18'	Labia striate except when young, visible as several parallel black lines; norstictic acid often present (in section red crystals develop with K)	20
19	Ascospores 5–8(–10) septate; lirellae very slender, always closed, immersed in raised thallus wall	<i>Graphis furcata</i>
19'	Ascospores 8–9 septate; lirellae wider, often showing a pruinose hymenium disc, without or with thin thallus cover	<i>Graphis scripta</i>
20	Ascospores nine-septate; exciple apically carbonized; no chemical compounds	<i>Graphis chlorotica</i>
20'	Ascospores to 11–15-septate; exciple laterally carbonized; norstictic acid present	21
21	Ascospores up to 11-septate, up to 60 µm long; ascomata prominent to sessile, without thallus margin except when very young; mature ascospores with rounded lumina and thick walls	<i>Graphis elegans</i>
21'	Ascospores up to 15 septate and up to 80 µm long; ascomata erumpent to prominent, with persistent lateral thalline margin; mature ascospores with elliptic lumina, which approach the wall closely	<i>Allographa verminosa</i>
22	(13) Ascospores 3–5-septate; no substances	<i>Phaeographis inusta</i>
22'	Ascospores 5–11-septate; norstictic acid	23
23	Ascospores 5–7-septate, excipulum laterally carbonized	<i>Phaeographis smithii</i>
23'	Ascospores (5–)7–11-septate, excipulum completely carbonized	<i>Phaeographis dendritica</i>
24	(1) Ascomata lirelliform; ascospores one-septate, hyaline	<i>Anomalographis madeirensis</i>
24'	Ascomata rounded; ascospores muriform, gray-brown	25
25	Ascomata perithecoïd	26
25'	Ascomata urceolate to lecanoroid	29
26	Growing on calciferous rock	<i>Diploschistes candidissimus</i>
26'	Growing on acidic rock	27
27	Thallus thin, C–	<i>Diploschistes euganeus</i>
27'	Thallus medium- to rather thick, C+ red	28
28	Thallus dull yellow to white-gray	<i>Diploschistes actinostomus</i>
28'	Thallus shiny lead-gray to blue-gray	<i>Diploschistes caesioplumbeus</i>
29	When juvenile lichenicolous on <i>Cladonia squamules</i> , later becoming terricolous	<i>Diploschistes muscorum</i>
29'	Saxicolous or on rocky soil	30
30	On calcareous rock	<i>Diploschistes gypsaceus</i>
30'	On acidic rock	31
31	Thallus K+ turning red (norstictic acid); apothecia sessile	<i>Xalocoa ocellata</i>
31'	Thallus K–; apothecia erumpent	32

- 32 Thallus coarsely cracked areolate, surface uneven to verrucose, greenish gray to gray; among mosses on rocks *Diploschistes scruposus*
- 32' Thallus verruculose to bullate or plane, whitish gray; on rocky soil *Diploschistes diacapsis*

#### 4. Conclusions

The islands of Macaronesia are popular among Western European naturalists and seemingly everywhere lichens were collected. However, these were published rather incidentally, and no thorough revision was ever made for most of the lichen groups. We revised the family Graphidaceae, excluding the thelotremoid species, and found that the most diverse genus of the family, *Graphis*, is represented by seven species, three not known from the region before, and none endemic. Two species of the recently segregated genus *Allographa* are also new records. The inconspicuous genus *Fissurina* was evidently much undercollected, and we recognized eight species, several are additional, not known before, and all present in our own collections. Three of the *Fissurina* species were undescribed and endemic to the Azores. The genus *Topeliopsis* was known from the Azores with one endemic species, *Topeliopsis azorica*, and we recognized a further endemic species. Altogether the family Graphidaceae is now known to be represented by 44 species, recorded from all three archipelagos, but mainly the Azores.

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