



GRAPHIS¹

Gintaras Kantvilas²

Graphis Adans., *Fam. Pl.* 2: 11 (1763)

Type: *G. scripta* (L.) Ach.

Thallus crustose, ecorticate, usually containing abundant calcium oxalate crystals. Photobiont *Trentepohlia*, with cells ellipsoid to subglobose, 8–16 × 6–12 μm, scattered or clustered. Ascromata apothecia, lirelliform, immersed, erumpent or sessile, simple to highly branched, scattered or clustered, with or without a lateral thalline margin. Disc usually concealed. Proper exciple black, entire, occasionally longitudinally striate, in section apically, laterally or entirely carbonised, brown and opaque, K–. Hypothecium hyaline to pale yellowish or brown. Hymenium hyaline, I+ yellow-brown, KI–, clear or interspersed with oil droplets, commonly overlain by a diffuse, brown epithelial layer. Asci elongate-clavate, 8-spored, of the *Graphis*-type: non-amyloid, with a slightly thickened apex and ± truncate ascoplasm. Paraphyses simple to sparsely branched, straight and parallel; apices typically hyaline and not expanded. Ascospores fusiform, with rounded or tapered apices, transversely septate or muriform, non-halonate, hyaline, I+, KI+ reddish purple at the septa; locules lens-shaped. Conidiomata unknown. Chemistry: most species lack substances, but depsidones, especially stictic or norstictic acids, are frequent.

A large genus of well over a thousand, mostly corticolous species, recognised by their elongate apothecia that usually appear as sinuous lines. The diversity of *Graphis* is greatest in the tropics and subtropics, with relatively few species in cool temperate areas (for example, there only about five in Britain). Tasmania is no exception with only nine species present, compared to more than 50 known from mainland Australia where the genus is concentrated in the warm temperate, subtropical and tropical forests of the coastal ranges. The suite of Tasmanian species consists mostly of relatively widespread taxa at the southern limit of their ecological range. Several Australian species extend as far south as Victoria but are yet to be recorded in Tasmania. Traditionally, the genus was characterised by having hyaline, transversely septate ascospores, but extensive studies based on anatomy, morphology, chemistry and, most recently, molecular data have seen the genus extensively refined and subdivided into more natural units. In addition to *Graphis* itself, relatively few “graphid” genera occur in Tasmania: *Acanthothecis* (2 species), *Fissurina* (4), *Halegrapha* (1), *Leiorrumma* (1) and *Phaeographis* (1). Critical characters in the taxonomy of *Graphis* in Tasmania are the morphology of the lirellae, whether the exciple is entirely or only laterally carbonised, the interspersing of the hymenium, and ascospore size. Determining whether the exciple is basally open can be tricky because in some specimens, the carbonised sides converge at the base, or the area between them is bridged by brownish (but not opaque) tissue; multiple observations are recommended. Spore size can vary considerably within a single thallus and determination of size ranges should also be based on multiple observations. Thallus chemistry is critical but rather simple, with Tasmanian species either lacking substances or containing norstictic acid. However, due to the thinness of the thallus and low concentration of substances, negative results from thallus spot tests or microscope squashes require confirmation by TLC. Traditionally most Tasmanian specimens of *Graphis* were lumped under the name *G. scripta*, a species that does not occur in Australasia.

Key references: Archer (2001, 2006, 2009); Lücking et al. (2009); Weerakoon et al. (2019).

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2 Tasmanian Herbarium, Tasmanian Museum & Art Gallery, PO Box 5058, UTAS LPO, Sandy Bay, TAS 7005, Australia.

1	Ascospores muriform Ascospores transversely septate	9 <i>G. subvelata</i> 2
2(1)	Exciple conspicuously longitudinally striate Exciple entire, not striate, or if striate then very inconspicuously so	8 <i>G. striatula</i> 3
3(2)	Hymenium clear; norstictic acid present or absent Hymenium inspersioned with oil droplets; norstictic acid present	4 7
4(3)	Exciple entirely carbonised; thallus lacking lichen substances Exciple laterally carbonised only; thallus lacking lichen substances or containing norstictic acid	5 6
5(4)	Mature ascospores 20–33 × 5.5–9 µm Mature ascospores 31–50 × 7–9 µm	4 <i>G. dracaenae</i> 6 <i>G. geraensis</i>
6(4)	Thallus containing norstictic acid Thallus lacking lichen substances	7 <i>G. librata</i> 5 <i>G. furcata</i>
7(3)	Labia gaping, with the disc exposed Labia convergent, with the disc concealed	1 <i>G. aperiens</i> 8
8(7)	Lirellae to 8 mm long, branched, sinuous and often clustered; ascospores 18–26 µm long Lirellae mostly to 1.5 mm long, simple to sparsely branched, scattered; ascospores 20–38 µm long	2 <i>G. centrifuga</i> 3 <i>G. desquamescens</i>

1 *Graphis aperiens* Müll.Arg.

Flora 74: 113 (1891).

Thallus greyish white, smooth to rather scurfy and lumpy, especially around the lirellae, 100–250 µm thick, forming diffuse patches to 20 mm wide; calcium oxalate crystals abundant. Lirellae superficial to semi-immersed, simple or occasionally branched, straight or sinuous, scattered, to 1–5 mm long and 0.15–0.3 mm wide, with a thin, basal thalline margin; disc soon exposed, black, epruinose. Exciple black, with labia entire, gaping in the central parts of the lirellae, in section entirely carbonised, 25–60 µm thick laterally, 50–80 µm thick basally. Hypothecium 25–40 µm thick. Hymenium densely inspersioned with oil droplets, 60–70 µm thick; asci 50–65 × 14–20 µm; paraphyses 1.5–2 µm wide, with brownish apices to 3 µm wide. Ascospores transversely 6–8-septate, (16–)18–21.7–26.5(–28) × (5–)5.5–7.0–8 µm.

Chemistry: norstictic acid, typically in low concentrations.

Apparently rare in Tasmania and known from two localities in the north-east where it grows on the smooth bark of *Pomaderris* in wet forest; also known from eastern mainland Australia and Japan. The thallus chemistry, inspersioned hymenium and ascospore size are similar in *G. centrifuga* and *G. desquamescens*, but *G. aperiens* differs by having wider lirellae where the disc is exposed and clearly visible. According to Lücking *et al.* (2009), the disc of this species is pruinose, although all Australian specimens are epruinose (Archer 2009).

German Town, 5 km NNE of St Marys, 41°32'S 148°12'E, 280 m, 1988, *J.A. Curnow* 2455 (CANB); Stony Head MTA, Ryans Hill, 41°01'S 147°02'E, 210 m, 2021, *G. Kantvilas* 141/21A (HO).

2 *Graphis centrifuga* Räsänen

Suom. Elain-ja Kasvit. Seuran Van. Tiedon. Pöytäkirjat 3: 186 (1949).

Thallus greyish white, smooth or rimose, 20–100 µm thick, forming continuous, diffuse patches to 50–100 mm wide; calcium oxalate crystals generally few and confined to the margins of the lirellae. Lirellae superficial to semi-immersed, usually richly branched, straight or sinuous, commonly clustered, to 8 mm long and 0.1–0.15 mm wide, with a thin, basal thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section entirely carbonised, 25–60 µm thick laterally, 50–90 µm thick basally. Hypothecium 20–50 µm thick. Hymenium interspersed with oil droplets, 60–80 µm thick; asci 55–80 × 14–19 µm; paraphyses 1.5–2 µm wide, not capitate but occasionally pigmented towards the tips. Ascospores transversely 6–7(–8)-septate, 18–21.7–25(–26) × (5.5–)6–6.5–7.5(–8) µm.

Chemistry: norstictic acid, typically in low concentrations.

Occasional in Tasmania and found mostly in rainforest where it occurs on the smooth bark of understorey trees; also known from the eastern Australian mainland. This species is distinguished by the combination of a basally carbonised exciple, an interspersed hymenium and the presence of norstictic acid. The rather similar *G. desquamescens* has a thicker thallus heavily interspersed with calcium oxalate crystals, shorter lirellae and longer ascospores, although the two species can be tricky to distinguish.

Holwell Gorge, 41°16'S 146°46'E, 200 m, 1980, *G. Kantvilas 200/80* (HO); Weldborough, 41°12'S 147°54'E, 640 m, 1981, *G. Kantvilas F-254* (HO); Murchison Hwy at saddle over Mt Black, 41°47'S 145°35'E, 530 m, 1989, *G. Kantvilas 271/80* (HO).

3 *Graphis desquamescens* (Fée) Zahlbr.

Denkschr. Kaiserl. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 83: 108 (1909); —*Opegrapha desquamescens* Fée, *Bull. Soc. Bot. France* 21: 24 (1874).

Thallus greyish white, generally rather uneven and lumpy, 100–150 µm thick, forming irregular, diffuse patches to 50 mm wide, densely interspersed with calcium oxalate crystals. Lirellae superficial to semi-immersed, simple to sparingly branched, straight or sinuous, scattered, mostly to 1.5 mm long and 0.1–0.15 mm wide, with a relatively prominent basal thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section entirely carbonised, 25–50 µm thick laterally, 20–90 µm thick basally. Hypothecium 10–30 µm thick. Hymenium interspersed with oil droplets, 65–80 µm thick; asci 55–75 × 12–16 µm; paraphyses 1.5–2 µm wide, not capitate but occasionally pigmented towards the tips. Ascospores transversely 6–7-septate, (20–)22.5–28.8–36(–38) × 6–7.1–8.5 µm.

Chemistry: norstictic acid, typically in low concentrations.

Widespread in eastern mainland Australia and New Zealand and also known from the Neotropics and Japan. It is relatively uncommon (or undercollected) in Tasmania where it occurs on smooth bark and appears to favour drier habitats such as coastal woodlands, in contrast to its close relative, *G. centrifuga*, which occurs in rainforest. To distinguish the two species on spore size alone requires multiple observations, although *G. desquamescens* differs further in having shorter, generally simple lirellae (those of *G. centrifuga* are long, branched and sinuous). The thicker, lumpier thallus and high concentration of calcium oxalate crystals in *G. desquamescens* may be due to its drier habitat.

Trevallyn SRA, 41°27'S 147°06'E, 200 m, 1992, *A.V. Ratkowsky* (HO); Stanley Peninsula, c. 30 m E of Wells Rd, 40°45'S 145°17'E, 50 m, 1998, *A.M. Gray* (HO); Stony Head MTA, Ryans Hill, 41°01'S 147°02'E, 210 m, 2021, *G. Kantvilas 141/21* (HO).

4 *Graphis dracaenae* Vain.

In W.P. Hiern, *Cat. Afr. Pl.* 2(2): 439 (1901).

Graphis immersicans A.W.Archer, *Austral. Syst. Bot.* 14: 262 (2001).

Thallus pale grey, smooth or rimose, 60–100(–300) µm thick, forming continuous, diffuse patches to 50–100 mm wide, densely interspersed with calcium oxalate crystals. Lirellae superficial to semi-immersed, simple or branched, straight or sinuous, to 6 mm long and 0.15 mm wide, with a basal thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section entirely carbonised, 20–50 µm thick laterally, at

the base 30–69(–90) μm thick, occasionally yellow-brown and only weakly carbonised. Hypothecium 20–40 μm thick. Hymenium clear, not inspersed with oil droplets, 80–120 μm thick; asci 65–90 \times 12–20 μm ; paraphyses 1.5–2 μm wide, not capitate but occasionally diffusely brownish at the apex. Ascospores transversely (5–)7–8(–9)-septate, (20–)21.5–25.8–31.5(–33) \times (5.5–)6–7.3–8(–9) μm .

Chemistry: nil.

A widespread, pantropical species, widely distributed in eastern Australia. In Tasmania, it is one of the more common species of *Graphis*, and is found on smooth-barked understorey trees in rainforest and wet sclerophyll forest. It is distinguished by the combination of a thallus lacking lichen substances, a clear, non-inspersed hymenium and the entirely carbonised exciple. Whereas Archer (2009) considered his *G. immer-sicans* (based on an Australian type) to be synonymous with *G. dracaenae* (based on a type from Angola), Lücking (2009) maintained these taxa as separate; further study is required to establish which name is more appropriate for the Tasmanian entity.

Golden Valley, 41°38'S 146°43'E, 450 m, 1965, G.C. Bratt 2434 (BM, HO); Davey River, 43°06'S 145°59'E, 20 m, 1990, G. Kantvilas 163/90 (HO); Stony Head MTA, Ryans Hill, 41°01'S 147°02'E, 210 m, 2021, G. Kantvilas 140/21 (HO).

5 *Graphis furcata* Fée

Essai Crypt. Exot.: 40 (1825).

Thallus pale grey to greyish white, smooth or rimose, 30–70 μm thick, forming continuous, diffuse patches to 100 mm wide, usually inspersed with abundant calcium oxalate crystals. Lirellae superficial to semi-immersed, simple or branched, straight or sinuous, to 8 mm long and 0.12–0.2 mm wide, with a thin, basal thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section laterally carbonised, 40–130 μm thick, open at the base or almost so, sometimes with the carbonised exciple converging at the base or bridged by dark yellow-brown tissue. Hypothecium 20–30 μm thick. Hymenium clear, not inspersed with oil droplets, 70–90 μm thick; asci 55–80 \times 12–20 μm ; paraphyses 1.5–2 μm wide, not capitate. Ascospores transversely 6–8-septate, (18–)19–24.7–30(–31) \times (5.5–)6–6.8–8 μm .

Chemistry: nil.

A widespread, chiefly pantropical species, uncommon (or overlooked) in Tasmania where it grows on the trunks of *Atherosperma moschatum* in rainforest. The name is applied here with much caution, and is ascribed to specimens with a basally open exciple and a thallus lacking lichen substances; the latter feature distinguishes it from *G. librata*. In the past this species was sometimes confused with *G. tenella*, which has longitudinally striate lirellae.

Adamsons Road, 43°20'S 146°58'E, 100 m, 1981, G. Kantvilas 1071/81 (HO); Ben Ridge Road, 850 m, 1981, G. Kantvilas 1115/81 (HO); Pieman Road near Huskisson River, 41°44'S 145°29'E, 230 m, 1989, G. Kantvilas 25/89 (HO).

6 *Graphis geraensis* Redinger

Ark. Bot. 27A(3): 12 (1935).

Essentially morphologically identical to *G. dracaenae*, and likewise with semi-immersed, sinuous lirellae, a basally closed, entire exciple, non-inspersed hymenium and lacking lichen substances. It differs by the larger, 7–9-septate ascospores, 31–38.6–44.5(–50) \times 7–8–9 μm .

Widespread across the southern and eastern Australian mainland, and also occurring in the Neotropics. It is seemingly rare in Tasmania and has been recorded from the bark of *Pomaderris apetala* in wet sclerophyll forest.

Stony Head MTA, Ryans Hill, 41°01'05"S 147°01'43"E, 210 m, 2020, G. Kantvilas 204/20 (HO); N of Branxholm, 41°06'S 147°44'E, 220 m, 2022, G. Kantvilas 482/22 (HO).

7 *Graphis librata* C.Knight

Trans. New Zealand Inst. 16: 404 (1884).

Thallus pale grey to greyish white, smooth or rimose, sometimes very thin and patchy, 20–60 µm thick, forming continuous, diffuse patches to 50–100 mm wide; calcium oxalate crystals often absent or very few. Lirellae superficial to semi-immersed, simple or branched, straight or sinuous, sometimes in stellate clusters, to 6 mm long and 0.15 mm wide, with a thin, basal thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section laterally carbonised, 15–50 µm thick, open at the base or almost so, sometimes dark yellow-brown. Hypothecium 20–50 µm thick. Hymenium clear, not interspersed with oil droplets, 60–90 µm thick; asci 50–70 × 12–20 µm; paraphyses 1.5–2 µm wide, not capitate. Ascospores transversely 6–7(–9)-septate, (17–)18–24.0–31.5(–33) × 6–7.0–8.5(–9) µm.

Chemistry: norstictic acid, typically in low concentrations.

A widespread species in eastern Australia, New Zealand and the Neotropics; occasional in Tasmania in wet forest, chiefly in the north-west, where it occurs on smooth bark in the shaded understorey. It is characterised by the combination of a clear, non-interspersed hymenium, laterally carbonised exciple and the presence of norstictic acid. Two superficially similar species, *G. furcata* and *G. dracaenae*, differ by lacking norstictic acid, with the latter differing further in having an entirely carbonised exciple.

Savage River Pipeline, 41°16'S 145°19'E, 480 m, 1980, *G. Kantvilas* 716/80 (BM, HO); Corinna, 41°39'S 145°05'E, 80 m, 1982, *G. Kantvilas* s.n. (HO); Savage River NP, E side of Baretop Ridge, 41°18'37"S 145°26'51"E, 2015, *G. Kantvilas* 58/15 (HO).

8 *Graphis striatula* (Ach.) Spreng.

Syst. Veg. 4: 250 (1827); —*Opegrapha striatula* Ach., *Syn. Meth. Lich.*: 74 (1814); *Allographa striatula* (Ach.) Lücking & Kalb, in J. Kalb, R. Lücking & K. Kalb, *Phytotaxa* 377: 26 (2018).

Thallus whitish, smooth, 15–50 µm thick, forming small, diffuse patches to 10 mm wide; calcium oxalate crystals restricted mainly to the vicinity of the lirellae; medulla sometimes l+ blue. Lirellae superficial, prominent, mostly simple and straight, 1–4.5 mm long and 0.4 mm wide, lacking a thalline margin; disc obscured. Exciple black, with labia convergent, longitudinally striate, in section entirely carbonised or almost so, 50–180 µm thick laterally, with the gaps between lamellae densely interspersed with calcium oxalate crystals, at the base 60–120 µm thick. Hypothecium 30–70 µm thick. Hymenium clear, not interspersed with oil droplets, 100–140 µm thick; asci 80–130 × 25–30 µm; paraphyses 1.5–2 µm wide, not capitate, diffusely brownish at the apex. Ascospores transversely 8–12-septate, (35–)37.5–51.1–65(–75) × (8–)9.5–12.3–15(–16) µm.

Chemistry: nil.

As a result of an extensive molecular investigation of the genus *Graphis* (Rivas Plata *et al.* 2011), this species is now included in the genus *Allographa*. However, because the name *G. striatula* is applied in Tasmania with some hesitation and, furthermore, there do not seem to be consistent morphological or anatomical characters by which to distinguish *Graphis* and *Allographa*, the taxon is retained here within *Graphis*. In the Tasmanian flora, this species is recognised by the short, prominent, longitudinally striate lirellae and relatively large ascospores, characters not seen in any other species of *Graphis*. The endospore, where the amyloid reaction occurs, is relatively wide in this species (c. 3 µm) and consequently the amyloid reaction masks the locules and septa; in other species, iodine tends to enhance the visibility of these features. *Graphis striatula* is a pantropical species that is rare in Tasmania, where it occurs on the twigs of understorey shrubs.

Anthony Road, 41°49'S 145°38'E, 480 m, 1993, *G. Kantvilas* 235/93 (HO); Savage River NP, E side of Baretop Ridge, 41°18'37"S 145°26'51"E, 580 m, 2015, *G. Kantvilas* 57/15 (HO).

9 *Graphis subvelata* Stirt.

Queensland Agric. J. 5: 488 (1899); —*Graphina subvelata* (Stirt.) Zahlbr., *Cat. Lich. Univ.* 2: 428 (1923).

Thallus pale grey, smooth, patchy or continuous, 40–100 µm thick, forming small, diffuse patches to 15 mm wide, densely interspersed with calcium oxalate crystals. Lirellae superficial to semi-immersed, scattered, simple or branched, straight or sinuous, to 2 mm long, with a rather scurfy, sometimes incomplete thalline margin; disc obscured. Exciple black, with labia convergent and entire, in section laterally carbonised, 20–

30 µm thick, open at the base. Hypothecium 10–20 µm thick. Hymenium 80–120 µm thick, interspersed with crystals and occasional oil droplets; asci 75–90 × 25–30 µm; paraphyses (1–)1.5–2 µm wide, not capitate. Ascospores muriform, with 5–8 transverse and 2–4 longitudinal septa, (15–)26–33.2–43(–45) × (10–)12–15.3–18(–19) µm.

Chemistry: nil.

Uncommon but widespread, with a range encompassing south-eastern Queensland, the Northern Territory, New Zealand and south-east Asia. In that respect, the single Tasmanian record, from an introduced elm tree in a public park, is unusual. This is the only Tasmanian *Graphis* species with muriform ascospores.

Westbury Green, 41°31'42"S 146°49'46"E, 180 m, 1977, R.D. Seppelt 5297 (HO).

REFERENCES

- Archer AW (2001) The lichen genus *Graphis* (Graphidaceae) in Australia. *Australian Systematic Botany* **14** 245–271.
- Archer AW (2006) The lichen family Graphidaceae in Australia. *Bibliotheca Lichenologica* **94** 1–191.
- Archer AW (2009) Graphidaceae. *Flora of Australia* **57** 84–194.
- Lücking R, Archer AW, Aptroot A (2009) A world-wide key to the genus *Graphis* (Ostropales: Graphidaceae). *Lichenologist* **41** 363–452.
- Rivas Plata E, Hernández C, Jesús E, Lücking R, Staiger B, Kalb K, Cáceres MES (2011) *Graphis* is two genera: a remarkable case of parallel evolution in lichenized Ascomycota. *Taxon* **60** 99–107.
- Weerakoon G, Aptroot A, Lücking R, Arachchige O, Wijesundara S (2019) *Graphis* and *Allographa* (lichenized Ascomycota: Graphidaceae) in Sri Lanka, with six new species and a biogeographical comparison investigating a potential signature of the 'biotic ferry' species interchange. *Lichenologist* **51** 515–559.

INDEX

A		
<i>Acanthothecis</i>	1	
<i>Allographa</i>	5	
<i>Allographa striatula</i>	5	
<i>Atherosperma moschatum</i>	4	
F		
<i>Fissurina</i>	1	
G		
<i>Graphina subvelata</i>	5	
<i>Graphis</i>	1, 4–6	
<i>Graphis aperiens</i>	2	
<i>Graphis centrifuga</i>	2, 3	
<i>Graphis desquamescens</i>	2, 3	
<i>Graphis dracaenae</i>	3, 4, 5	
<i>Graphis furcata</i>	4, 5	
<i>Graphis geraensis</i>	4	
<i>Graphis immersicans</i>	3, 4	
<i>Graphis librata</i>	4	
		<i>Graphis scripta</i>1
		<i>Graphis striatula</i>5
		<i>Graphis subvelata</i>5
		<i>Graphis tenella</i>4
H		
<i>Halegrapha</i>	1	
L		
<i>Leiorrumma</i>	1	
O		
<i>Opegrapha desquamescens</i>	3	
<i>Opegrapha striatula</i>	5	
P		
<i>Phaeographis</i>	1	
<i>Pomaderris</i>	2	
<i>Pomaderris apetala</i>	4	
T		
<i>Trentepohlia</i>	1	