

Graphis Adans.
(GRAPHIDALES: GRAPHIDACEAE)

After Fink (1935), Wirth & Hale (1978), and Harris (1990, 1995)

Rev. 5/94

Thallus crustose, uniform, epi- or endo-phloic, ecorticate or with a cortex of interwoven periclinial hyphae; attached by medullary or prothallial hyphae.

Apothecia usually elongate, simple or often branched or stellate, immersed to emergent or sessile; disk narrow; thalline exciple absent; proper exciple often partly or totally black (carbonaceous), or yellow or colorless, opaque, prominent and strongly developed, connivent (closed) or not, entire or sometimes longitudinally furrowed (in cross section the labia appearing crenate-sulcate), rarely pale; complete (closed at base) or dimidiate (open at base); hypothecium hyaline to pale or black, thin; hymenium I-; paraphyses slender, unbranched, not thickened at apices; asci clavate to subcylindrical, unitunicate (non-fissitunicate, dehiscence by an apical split), I-, (1-)2-4-8-spored; spores transversely 3-many septate, oblong-ellipsoid to fusiform, hyaline at maturity (sometimes brownish when overripe), walls unequally thickened resulting in lenticular to rounded locules, I+ violet.

Pycnidia rare, immersed; fulcrum exobasidial; pycnospores oblong-cylindrical to bacilliform. Norstictic, stictic, protocetraric, salazinic, lecanoric, or no substances; old apothecia of some species sometimes with a K+ purple anthraquinone. Photobiont Trentepohlia. On wood and bark, rarely on leaves or rock. Primarily tropical-subtropical, but some species common in temperate to boreal areas.

Superficially resembling Opegrapha, which has fissitunicate asci, I- ascospores and anastomosed hamathecial elements. Phaeographis differs in having ascospores brown when mature.

A primarily tropical-subtropical genus, although G. scripta, G. elegans, and a few others, definitely occur in northern areas, and G. scripta is very common in parts of the Pacific NW. Many of the species from N. America other than Florida have not been well studied, and I do not yet have a full key that includes them.

The following is a key to the three species reported from the Pacific NW; the rest of the species, as far as known, are southern only.

I. Species Found in Pacific NW (or other northern areas)

1. Margin striate (furrowed). Thallus K+, P+ or K-, P-. 2

1. Margin not striate. Thallus K-, P- (no substances). Disk becoming exposed, whitish or bluish pruinose; exciple carbonized, but mostly not to base; spores (6-)8-11(15)-celled, (20-)30-40(-45) x 7-9(-10) μm . Ascocarps \pm branched, elongate, black, epruinose; exciple \pm dimidiate; labia distinctly carbonized, without individually carbonized hyphae. Widespread, including from Florida to New England, and Pacific NW. [Extremely variable; including: var. topegraphica, with apothecia to 8-10 mm long, straight and parallel, from northern United States, var. pulverulenta, with thick, powdery thallus, and var. limitata, with hypothalline lines on thallus] G. scripta (L.) Ach.

2. Thallus K+ yellow/red (norstictic acid). Spores 10-12-septate, 35-56 x 6-12 μm . Apothecia rarely branched; usually without prominent thalloid margin; exciples without red-yellow tissue below carbonized portions. Thallus smooth to wrinkled or granulose. Exciples open below. Ascocarps 3-6 x 0.5 mm, unbranched; labia convergent, with 2-5 striae. Spores 6-8/ascus. Reported from Washington state. G. elegans

2. Thallus K-, P- (no substances). Spores 7-septate, 23-28 x 6-7 μm . Apothecia much branched, Opegrapha-like, black; labia confluent with rest of exciple, not composed of free individually carbonized hyphae, the sulcae few; exciple carbonized laterally only (often labia apices only), open below. Hymenium not interspersed. Spores 8 per ascus. South Carolina, Louisiana and Florida; Reported from Washington state. G. striatula (Ach.) Sprengel

**II-A. Southern Species:
Exciple Carbonized;
Spores more than 4-celled (except in G. afzelii)**

1. Spores 4-celled. (see G. afzelii)
1. Spores more than 4-celled. 2
 2. Margin not striate; hymenium inspersed or not. 3
 2. Margin striate; hymenium not inspersed. 16
3. Ascomata sessile, covered with thin white layer; exciple well developed below hymenium. 4
3. Ascomata immersed or sessile, black, not covered by a white layer. 5
 4. Lirellae and thallus UV-, P-, C+ red (lecanoric acid). Spores 4-celled, 15-23 x 6-9 um. Thallus indicated by a brownish to ashy gray area. Ascocarps 1-9 x 0.3-1 mm, not fissurine, rarely branched; disc obvious, white powdery; exciple black, carbonized, covered by white veil, open below. North Carolina to Florida, west to Texas. G. afzelii Ach.
 4. Lirellae and thallus UV+ yellow (lichexanthone according to Harris, 1990, not mentioned by Hale), P+ red, C- (protocetraric acid). Spores ca. 22-23-celled, 60-95 x 7-9 um. Florida. G. candidata Nyl.
5. Epihymenium with numerous minute orange granules, K+ purple; lirellae flexose, branched; disk at most weakly exposed, orange; margin not striate. Thallus white, ecorticate. Spores 8/ascus, 8-celled. 6
5. Epihymenium hyaline, K-. 7
 6. Exciple closed (present below hymenium); hymenium yellowish inspersed; spores 27-34 x 7-8 um. Thallus K+ red, with norstictic acid. Lirellae semi-immersed; Exciple shiny, entire. Disk not exposed or weakly exposed. Florida. G. chromothecia R. C. Harris
 6. Exciple lacking below; hymenium not inspersed; spores 23-30 x 6-7 um. Thallus K-, without substances. Lirellae long. Exciple lacking below hymenium. Florida. G. inversa R. C. Harris
7. Exciple entire, carbonized below hymenium. 8
7. Exciple lacking below hymenium. 10
 8. Spores 6-8-celled, (18-)23-35(-50) x 5-8 um; hymenium inspersed. Ascocarps subsessile, black, Opegrapha-like, often branched, 0.5-3 mm long; exciple ± closed below, black; labia convergent, ± entire. Spores 8 per ascus. Thallus K+ red (norstictic acid). Florida. G. desquamescens (Fée) Zahlbr. s. lato
 8. Spores 11-15-celled, 50-60 x 8-10 um. 9

9. Hymenium inspersed; lirellae mostly immersed. Thallus K+ red, with norstictic acid (rarely acid deficient). Florida. G. sp. (Harris)

9. Hymenium not inspersed; lirellae sessile. Thallus K-, without substances. Thallus thin, gray-white, continuous. Lirellae prominent, flexuous, occasionally branched, very long (to 8 mm) and slender (0.3 mm), the ends acute; thalline margin thin to disappearing; proper exciple prominent, black, closing with a narrow slit. Spores 8 per ascus, 9-10-locular, 28-31 x 6-7 μ m. No substances. On bark. G. anfractuosa Eschw. in Martius

10. Thallus P+ orange or red, K+ yellow or red or K-(norstictic, stictic, or protocetraric acids). 11

10. Thallus P-, K-. No substances. 14

11. Norstictic acid only. 12

11. Stictic acid (with or without norstictic acid) or protocetraric acid). 13

12. Lirellae flexuose, branching, sessile to semi-immersed; hymenium not inspersed; spores 6-8-celled, 18-35 x 5-9 μ m. Thallus smooth, continuous, verrucose with occasional fissures, especially around lirellae, creamish yellow to grayish white. Lirellae raised, branched, flexuous, often crowded and tending to lie praealle, or sometimes more radiate and dendroid, 1-4 mm long and 0.2-0.4 mm wide; thalline exciple prominent, raised, distinct, and closely following the sinuous apothecia; proper exciple closing with a slit, base variable, open to closed, often brown. Spores 6-8 per ascus, (5-)6-8-locular, locules lenticular, 18-29 x 5-9 μ m. On bark. Florida and Louisiana. [including G. celtidis, with spores 8-12-celled, 24-38 x 8-10 μ m; ascocarps 1-4 x 0.2 mm, infrequently branched; disc \pm closed; exciple brown-black]. G. librata Knight s. lato

12. Lirellae short, straight, immersed; hymenium inspersed; spores 8(-9)-celled, 30-35 x 8-9 μ m. Florida. (G. sp. of Harris, 1990)

13. Lirellae immersed; margin and disk white pruinose; hymenium not inspersed; spores 8-11-celled, (20-)25-35(-40) x (6-)7-8(-10) μ m. Thallus K+ red (norstictic acid) or K-, P+ red (protocetraric acid). Ascocarps simple to branched, 0.5-4 mm long; labia divergent or slightly convergent. Exciple open below. Florida. G. caesiella Vainio s. lato

13. Lirellae semi-immersed, black; margin and disk not pruinose; hymenium inspersed; spores 10-11-celled, 30-40 x 7-8 μ m. Stictic acid, plus (in Florida material) norstictic acid (K+ red) Florida. G. leptocarpa Fée s. lato

14. Spores 11-13-celled, 50-70 x 8-11 μ m (Harris, 1990); hymenium inspersed. [Thallus wrinkled or granulose. Ascocarps 3-10 or more x 0.15-0.3 mm, sometimes \pm branched; disc closed; exciple black, pruinose above, open below. Spores 5-9-septate, 18-37 x 6-9 μ m. Texas, according to ?]. Florida. G. pavoniana Fée

14. Spores 8-11-celled, 25-40 μ m long; hymenium not inspersed. 15

15. Disk not exposed; exciple carbonized to base of hymenium; spores 8-10(-11)-celled, (16-)25-40(-50) x 7-9.5 μ m. Ascocarps 0.5-2(-3) x 0.1-0.35 mm; disc closed to very narrowly open and black; exciple black, open below. Florida. G. lineola Ach.

15. Disk becoming exposed, whitish or bluish pruinose; exciple mostly not carbonized to base; spores (6-)8-11(15)-celled, (20-)30-40(-45) x 7-9(-10) μ m. Ascocarps \pm branched, elongate, black, epruinose; exciple \pm dimidiate; labia distinctly carbonized, without individually carbonized hyphae. Thallus K-. Widespread, including from Florida to New England, and Pacific NW. [Including: var. topegraphica, with apothecia to 8-10 mm long, straight and parallel, from northern United States: var. pulverulenta, with thick, powdery thallus, and var. limitata, with hypothalline lines] G. scripta (L.) Ach.

16. Thallus UV+ yellow (lichexanthone; no other substances). Lirellae black; disk not exposed; exciple lacking below; exciple lacking below; hymenium not interspersed. 17

16. Thallus UV-. 18

17. Lirellae narrow, flexuose, branched; margin weakly striate; spores 8/ascus, 6-8-celled, 20-30 x 7-9 μ m. Thallus white, ecorticate. Florida. G. lucifica R. C. Harris

17. Lirellae rather broad, short, often straight, sparsely branched; margin strongly striate; spores (2-)8/ascus, 11-14-celled, 50-75 x 9-12 μ m. Florida. G. haleana R. C. Harris

18. Spores 14-19-celled, 55-80 μ m long. 19

18. Spores 8-12-celled, 20-45 μ m long. 20

19. Thallus K+ yellow (stictic acid). Exciple strongly developed below; spores ca. 14-celled, 55 x 8-9 μ m. Florida. G. sp. (Harris, 1990)

19. Thallus K+ red (norstictic acid). Exciple barely closed below; spores 16-19-celled, 70-80 x 10-11 μ m (narrower than indicated by Wirth & Hale, 1978, and base of exciple is less carbonized). Louisiana. G. lumbricina Vainio s. lato

20. Margin carbonized above, orange below; spores 9-10-celled, 25-27 x 6-7 μ m, often sterile. No substances. Florida. G. subelegans Nyl.

20. Margin carbonized to base of hymenium. 21

21. Thallus K+ yellow, P+ orange (stictic acid). Spores 8-celled, 23-28 x 6-7 μ m. Florida. G. sp. (Harris, 1990)

21. Thallus K-, P- (no substances). Spores 8-celled, 23-28 x 6-7 μ m. Apothecia much branched, Opegrapha-like, black; labia confluent with rest of exciple, not composed of free individually carbonized hyphae, the sulcae few; exciple carbonized laterally only (often labia apices only), open below. Spores 8 per ascus. South Carolina, Louisiana and Florida; Reported from Washington state. G. striatula (Ach.) Sprengel

**II-B. Southern Species:
Exciple Not Carbonized;
Spores 2-4-celled**

1. Spores 2-celled or 8-9-celled. 2a

1. Spores 4-celled. Thallus K-, P- (no substances). 2b

2a. Ascospores 2-celled. Thallus K+ red, P+ orange (norstictic acid), UV-. Thallus shiny. Thallus whitish, shiny. Lirellae fissurine, crowded, 0.5-2 x 0.25-0.4 mm, rarely short-branched; disc closed or narrowly open and dark colored; exciple pale to darker brown, open below. Lirellae initially with closed, ± pruinose lips, later disk exposed, pale, pruinose. Spores 8-11 x 3.5-4.5 µm. Florida. (also see Melaspilea). G. turbulenta Nyl.

2a. Ascospores 8-9-celled. Thallus K-, P-, UV+ yellow (lichexanthone). Thallus dull. Lirellae immersed; disk pale red-brown; margin white, patchily developed. Florida. G. anguinoides R. C. Harris ined.

2. Lirellae fissurine; exciple not evident. 3

2. Lirellae long, dichotomously branched; disk hidden to exposed; exciple orangish, well developed laterally or at base. 5

3. Margin swollen; spores 17-21 x 8-10 µm, 8/ascus, uniseriate, 4-locular. Thallus greenish gray to yellowish gray, thin, often cracked and fissured, especially around the lirellae, outer border of thallus marked by a black hypothallus; K-, P- (no substances). Ascocarps 1-3 x 0.3-0.6 mm, immersed, pale, flexuous, branched, fissurine (slit-like); thalline exciple wide, variable, sometimes raised around the lirellae, sometimes in the same plane and distinguished only by cracking parallel to the lirellae; proper exciple pale, uncarbonized, often turning brown. South Carolina to Florida and Texas. G. insidiosa (Knight & Mitten) Hook. f.

3. Margin not swollen; spores to 17 x 7 µm. 4

4. Thallus white, ecorticate; lirellae not gaping, minute (less than 2 mm long), immersed, visible only as thin lines, straight to curved, occasionally once branched; exciple not evident; hymenium not interspersed; ascospores 8/ascus, 15-17 x 6-7 µm. Florida. G. illiterata R. C. Harris

4. Thallus greenish, with shiny prosoplectenchymatous cortex; lirellae gaping; spores 11-13 x 5-6 µm (Harris, 1990). [Spores 7-9-septate, 20-30 x 6-9 µm according to ?]. Ascocarps 2-3(-5) x 0.15-0.25 mm, becoming sparingly branched, fissurine, the disc becoming open and whitish; exciples brownish, totally uncarbonized, covered by raised thalloid exciple but not embedded in swollen tissue; hypothecium hyaline. Florida and Louisiana. G. subnitidula Nyl. ex Tuck.

5. Disk exposed; "exciple" well developed below hymenium; spores 10-13 x 5 µm. Florida. G. grammatis Fée

5. Disk not exposed; exciple well developed laterally. 6

6. Margin not striate (or 1-3 times striate according to ?); spores 14-17(-20?) x 5.5-8 µm. [Apothecia curved, flexuous, and abruptly bent or recurved, 4-18 x 0.6-0.8 mm, the

disc usually closed; exciple reddish brown, open below, according to ?]. Florida. G. subparilis Nyl.

6. Margin striate; spores (14-)22-24 x (7-)10-13 um. Apothecia straight to curved and flexuous, 5-12 x 0.5-1 mm; disc closed; exciple reddish to dark brown, open below; Thallus greenish gray to olive-green. Florida. G. rufula Mont.

III. On rock.

G. saxorum Egea & Torrente

Thallus crustose, epilithic, creamy whitish or brownish, effuse, rimose-areolate with smooth surface, surrounded by thin, smooth, dark brown prothallus. In section, to 1 mm thick, with cortex to 40 um thick, mainly composed of intertwined hyphae; medulla white, of variable thickness, composed of loosely interwoven hyphae with many crystals of unknown nature (soluble in K) between the hyphae. Algae Trentepohlia-like.

Ascomata lirellate, 0.7-2.0 x 0.3-0.7 mm, simple or slightly branched, immersed to adnate, straight to curved, scattered, rarely 2-3 aggregated. Margin thick, often with thin layer of white pruina. Disc narrow, slit-like. Exciple thick, carbonaceous, open to closed at bottom. Epithecium not or poorly differentiated. Hymenium hyaline, 140-150 um thick, I-, K/I-. Subhymenium hyaline to yellowish, 100-200 um thick. Paraphyses up to 2.5 um wide, septate, slightly branched, not widened at apices. Asci cylindric, unitunicate, 90-110 x 16-20 um, octosporate, with uniseriate ascospores when young, non-amyloid or hemiamyloid. Ascospores oblong-ellipsoid to fusiform, hyaline, 21-28 x 8-11 um, with 3-5(-6) transverse septa (bicellular when young), thick-walled, with thickened septa, lumina lenticular, without gelatinous sheaths, I-.

Thallus K+ red, C-, P+ orange; norstictic and connorstictic acids.

On volcanic rocks, moderately shaded, vertical or almost, and on underhangs, etc. protected from rain, coastal California and Baja California.

ADD?:

Ascocarps furcately branched, 1-5 x 0.4-0.9 mm, becoming clustered; disc closed; exciple pale and rudimentary, covered by a thalloid one; hypothecium hyaline. Spores usually 8, 12-16 x 8-10 um, 4-celled. South Carolina and Alabama. (Medusulina nitida)

Apothecia straight or curved, 0.5-2 x 0.15-0.2 mm, often \pm clustered, at most sparingly branched, the disc closed to open and white, the exciple brownish, open below. Spores 4-celled, 14-20 x 3-4.5 um. Florida (but not mentioned by Harris, 1990). G. botryosa

Ascocarps 2-3-angled, 1-3 x 0.5-2 mm, unbranched, the disc soon open and whitish; exciple open below. Spores 14-18 x 5-7 um, 4-celled. Florida (but not mentioned by Harris, 1990). G. dumastii

Ascocarps fissurine, not embedded in swollen tissue, 0.5-4.0 mm long; exciple rudimentary at best, totally uncarbonized. Spores 4-celled, (14-)18-25 x (6-)8-9(-14) um, 8 per ascus, I-. Thallus K+ yellow (stictic acid). G. dumastioides

Spores 16-25 x 5-8 um, 5-9-septate. Labia without individually carbonized hyphae. Ascocarps 0.5-2 x 0.15-0.2 mm; disc finally open and black; labia black; exciple pale below. Florida. Possibly an immature Graphina, according to Harris, 1990. G. mosquitensis

Exciple closed below. Thallus K+ yellow (stictic acid). Ascocarps much branched, 1-5 x 0.3 mm, immersed, \pm pruinose; exciple black. labia entire, divergent; Spores 7-9-septate, 17-30 x 5-8 um. G. subamylacea

Thallus greenish gray to olive-green, K-, P-. Ascocarps immersed, 0.5-1 x 0.2-0.3 mm, K-, P+; disc partly closed to open and whitish powdery; exciple pale (at least below), rudimentary; hypothecium pale. Spores 4-8 per ascus, 13-20-septate transversely. Florida. Probably an immature Graphina according to Harris, 1990.(Graphina leucopepla)

Thallus smooth. Apothecia to 8-10 mm long, \pm branched. According to Wirth & Hale, spores under 15 um long but otherwise very similar to G. desquamescens. Fink gives spores as 20-46 x 6-8 um and reports the species from New Jersey to Florida. According to Harris, 1990, spores of Florida material of G. desquamescens are small, intermediate between those of the two species. G. intricata

Exciple not striate. Ascocarps 1-4 x 0.15-0.25 mm, mostly simple, the disc usually closed; exciple pale to brownish, open below. Spores 11-21-septate, 36-90 x 8-13 um. Florida, Georgia and Texas. Possibly an immature Graphina according to Harris, 1990; type not seen. G. poitaeoides

Exciple closed below. Thallus K+ yellow (stictic acid). Ascocarps immersed, \pm pruinose; much branched, 1-5 x 0.3 mm; exciple black; labia entire, divergent; Spores 7-9-septate, 17-30 x 5-8 um. G. subamylacea

Spores 5-9-septate, 18-40 x 6-9 μ m, 8 per ascus. Thallus K-, P- (no substances). Ascocarps 1-2(-5) x 0.15-0.3 mm, flexuous or curved, unbranched, the ends acute; thalline margin distinct, raised; proper exciple black, open and brown below; disc open, dark. Thallus thin, smooth to minutely roughened, continuous, grayish white. Alabama, Louisiana, and Florida (but not mentioned by Harris, 1990). G. tenella

Thallus K-, P- (no substances). Ascocarps covered by thalline veil that can be rubbed off, branched, 1.0-3.0 mm long; disc occasionally visible; exciple \pm open; labia \pm convergent, apically red-brown to barely carbonized, paler below. Spores ca. 6 per ascus, 7-13-septate, (35-)42-55 x 7-12 μ m. G. glaucescens

G. aperiens

G. platycarpella

Apothecia rarely branched; usually without prominent thalloid margin; exciples without red-yellow tissue below carbonized portions.

Thallus smooth to wrinkled or granulose, K+ yellow/red (norstictic acid). Exciples open below. Spores 10-12-septate, 35-56 μ m, 6-8 per ascus. Ascocarps 3-6 x 0.5 mm, unbranched; labia convergent, with 2-5 striae. Reported from Washington state. G. elegans

Thallus smooth to minutely rough, K-, P- (no substances). Apothecia 1.5-6 x 0.2-0.35 mm, not astroid; exciple open to closed below, partly brown laterally; labia very irregularly dissected and lacerate, \pm free, black, embedded in exciple. Spores 9-13-septate, 30-45(-70) x 8-10 μ m. Louisiana. G. rimulosa

EXCLUDED (ACCORDING TO HARRIS, 1990)

Spores 18-28 x 5-7 μ m, 5-7-septate, often brownish according to Fink. Ascocarps 1-4 x 0.2-0.4 mm, seldom branched; disc closed to open and reddish black; exciple reddish brown, closed below. South Carolina, Georgia and Florida. G. atrorubens. = Opegrapha longissima according to Harris, 1990

Spores 25-38 x 6-9 μ m, 5-13-septate, finally brown. Vermont and Illinois. (Phaeographis eulectra)

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