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A world-wide key to the genus *Graphis* (*Ostropales*: *Graphidaceae*)

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Abstract: A world-wide key to the genus *Graphis* is presented, based on extensive type studies and revision of several thousand historical and recent collections. A total of 330 species are accepted and included in the key, and a further 205 epithets are listed as synonyms. The structured key includes taxonomic information on type specimens of epithets considered to be synonyms of the accepted species. In addition, 28 species of other genera (*Carbacanthographis, Diorygma, Dyplolabia, Glyphis*) with carbonized excipulum and hyaline ascospores likely to be confused with *Graphis* are mentioned under the corresponding key couplets. Although the key is preliminary and some taxonomic and nomenclatural problems remain unresolved at this time, it should allow reliable identification of most specimens especially from tropical regions. The following 14 species are described as new: *Graphis brahmanensis* Aptroot sp. nov., *G. cupei* Vain. ex Lücking sp. nov., *G. funilina* Aptroot sp. nov., *G. inspersolongula* Aptroot sp. nov., *G. leucaenae* Aptroot sp. nov., *G. lourdesina* Aptroot sp. nov., *G. myolensis* Aptroot sp. nov., *G. nadurina* Aptroot sp. nov., *G. norstictica* Archer & Lücking sp. nov., *G. sarawakensis* Hale ex Lücking sp. nov., *G. slendrae* Hale ex Lücking sp. nov., *G. subintermedians* Hale ex Lücking sp. nov., *G. subserpens* Staiger sp. nov., and *G. syzygii* Aptroot sp. nov. In addition, 22 new combinations are proposed: *Carbacanthographis cleitops* (Fée) Lücking comb. nov., *C. coccospora* (Aptroot) Aptroot & Lücking comb. nov., *C. induta* (Müll. Arg.) Lücking comb. nov., *C. triphoroides* (M. Wirth & Hale) Lücking comb. nov., *Graphis apoda* (Zahlbr.) Lücking comb. et stat. nov., *G. cremicolor* (H. Magn.) Lücking & Archer comb. nov., *G. enteroleuca* (Ach.) Lücking comb. nov., *G. evirescens* (Redinger) Lücking comb. nov., *G. galactoderma* (Zahlbr.) Lücking comb. nov., *G. ingarum* (Vain.) Lücking comb. et stat. nov., *G. isidiata* (Hale) Lücking comb. nov., *G. japonica* (Müll. Arg.) A. W. Archer & Lücking comb. nov., *G. kousyuensis* (Horik. & M. Nakan.) Lücking comb. nov., *G. negrosina* (Vain.) Lücking comb. et stat. nov., *G. oxyspora* (Zahlbr.) Lücking comb. nov., *G. plumbea* (Zahlbr.) Lücking comb. nov., *G. riopiedrensis* (Fink) Lücking comb. nov., *G. semirigida* (Müll. Arg.) Lücking comb. nov., *G. subradiata* (Nyl.) Lücking comb. et stat. nov., *G. subtecta* (Nyl.) Lücking comb. et stat. nov., and *G. sulphurella* (Zahlbr.) Lücking comb. nov. Replacement names are established for six taxa: *Graphis jeanmuelleri* Lücking nom. nov. [≡ *Graphina elegantula* Müll. Arg., non *Graphis elegantula* Zahlbr.], *Graphis neoelongata* Lücking nom. nov. [≡ *G. elongata* Vain., non *G. elongata* Zenker], *Graphis novopalmicola* A. W. Archer & Lücking nom. nov. [≡ *Graphina palmicola* Müll. Arg., non *Graphis palmicola* Makhija & Adaw.], *Graphis paralleloides* Cáceres & Lücking nom. nov. [≡ *G. rimulosa* var. *parallela* Müll. Arg., non *G. parallela* Müll. Arg.], *Graphis subalbostriata* Lücking nom. nov. [≡ *G. angustata* var. *albostriata* Vain., non *G. albostriata* Vain.], and *Graphis subvernicosa* Lücking nom. nov. [≡ *Opegrapha vernicosa* Fée, non *G. vernicosa* Nyl.]. Three new synonyms are established for *Glyphis substriatula* (Nyl.) Staiger: *Graphina sulcatula* Müll. Arg., *G. sulcatula* var. *conglomerata* Müll. Arg., and *G. bakeri* Zahlbr.

Key words: *Carbacanthographis*, *Diorygma*, *Dyplolabia*, *Glyphis*

Introduction

Graphidaceae (now also including *Thelotremataceae*; Mangold *et al.* 2008) is by far the most dominant element in tropical crustose lichen communities (Wirth & Hale 1963, 1978; Hale 1974, 1978, 1981; Patwardhan & Kulkarni 1976, 1977, 1979*a–c*; Patwardhan & Nagarkar 1979; Sipman & Harris 1989;

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Archer 1999, 2000, 2001*a–e*, 2003*a*, *b*, 2005, 2006; Breuss 2000, 2001, 2004; Staiger 2002; Nakanishi *et al.* 2003*a*; Makhija & Adawadkar 2005*a*, *b*; Makhija *et al.* 2005*a*, *b*, 2006; Cáceres 2007; Lücking *et al.* 2008, 2009). For a long time, the graphidoid members of *Graphidaceae sensu* Staiger (2002) were divided into the genera *Graphis, Graphina, Phaeographis*, and *Phaeographina*, depending on whether the ascospores are transversely septate or muriform, colourless or greyish brown. This concept was considered artificial (Wirth & Hale 1963, 1978; Harris 1990, 1995), and revisions of *Acanthothecis* and *Dyplolabia* (Staiger & Kalb 1999; Kalb & Staiger 2000) set the stage for an approach towards a more natural generic classification of the family (Staiger 2002; Kalb *et al.* 2004). A set of characters such as excipulum and hamathecium structure, ascospore colour and iodine reaction, and chemistry, was proposed to achieve a much more satisfying genus concept. This concept was widely accepted (Nakanishi *et al.* 2003*b*; Archer 2005, 2006; Makhija & Adawadkar 2005*a*, *b*; Makhija *et al.* 2005*a*, *b*, 2006; Lücking *et al.* 2008, 2009; Lendemer & Knudsen 2008) and is largely supported by molecular phylogenetic approaches (Kalb *et al.* 2004; Staiger *et al.* 2006; Mangold *et al.* 2008), although inexplicably the few species of *Graphis* studied so far fall into two different clades, with no supporting morphological characters. Including the recent revision of *Diorygma* (Kalb *et al.* 2004), which synonymizes *Cyclographina, Glaucinaria*, and *Solenographa* with the latter, 24 graphidoid genera are now distinguished in the family (Staiger 2002; Archer 2006; Aptroot & Sipman 2007; Lücking & Rivas Plata 2008; Tehler *et al.* 2008).

With the revised concept, *Graphis* remains by far the largest genus in the family, with over 300 taxa presently accepted, accounting for more than half of all graphidoid species. Since species of *Graphis* were traditionally characterized by transversely septate, hyaline ascospores, including species now assigned to genera such as *Acanthothecis, Anomomorpha, Carbacanthographis, Diorygma, Dyplolabia, Fissurina, Platythecium*, and *Thalloloma*, their delimitation concentrated on gross morphology of the excipulum, ascospore size, and number of septa, as well as secondary chemistry (Wirth & Hale 1963, 1978; Patwardhan & Kulkarni 1976, 1977, 1979*a–c*; Patwardhan & Nagarkar 1979; Archer 1999, 2000, 2001*a–e*, 2003*a*, *b*). However, the revised circumscription of the genus by Staiger (2002) required a more detailed approach towards species delimitation, as well as re-evaluation of a whole set of characters for taxonomic purposes (Lücking *et al.* 2008; Lücking 2009, this volume).

In order to clarify the taxonomy in the genus *Graphis*, over the past few years we have revised a large number of collections from all parts of the tropics (see Lücking 2009, this volume, for detailed information on collections studied), as well as type material of nearly 90% of the described epithets belonging in the genus. To make this information available, we have compiled a preliminary world-wide key to species of *Graphis sensu* Staiger (2002), including taxonomic data of all type specimens investigated. Although this key is neither complete nor perfect, we prefer to publish it now and resolve the few remaining problems as material becomes available. As it is, the key provides a vast amount of new and updated information and should allow reliable identification of the bulk of tropical *Graphis* material (we have not yet attempted to resolve the extratropical *Graphis scripta* complex). The key implements a revised species concept (Lücking 2009, this volume) and attempts to clarify common misconceptions regarding the taxonomy of this genus.

The Genus *Graphis*

Key Characters

The taxonomy of the genus *Graphis sensu* Staiger (2002) was revised in a separate paper (Lücking 2009, this volume). The key is based on the results of that study and uses the following suite of morphological, anatomical, and chemical characters to delimit species.

Thallus colour. Most species have a white-grey thallus due to the presence of large clusters of calcium oxalate crystals in and above the photobiont layer. A few taxa have an olive-green colour, similar to *Phaeographis* and related genera, because the crystal clusters are located below the photobiont layer (Lücking 2009, this volume). In species with high concentrations of norstictic or stictic acid, the thallus might appear pale yellowish. Discoloration in herbarium material is common and due to improper drying which causes decomposition of chlorophyll (yellow to yellow-brown colour of originally white-grey or olive-green thalli) or secondary substances (red-brown colour in specimens containing norstictic or salazinic acid). In such cases, a hand-cut section of the thallus helps to identify the thallus type and natural colour (Fig. 1A–B).

Thallus cortex. Species with a corticate thallus have a compact, slightly glossy surface, whereas ecorticate taxa show a matt, rough or farinose thallus under the dissecting microscope. If present, a cortex is identified as a thin but distinct, hyaline layer of compacted, parallel hyphae in hand-cut sections under the compound microscope (Fig. 1A–B).

Vegetative propagules. Only four species have isidia and one (*G. sorediosa*) has soralia. Isidia are usually numerous in *G. isidiata* (Fig. 1C), *G. isidiza*, and *G. patwardhanii* (Fig. 1D), but scattered and easily overlooked in *G. stellata*, so careful inspection of the thallus surface is required.

Lirella emergence. Lirella emergence can be categorized into four states (Fig. 2): 1) immersed (upper part of hymenium more or less level with thallus surface, labia flush or slightly emergent; Fig. 2A); 2) erumpent (upper part of hymenium above, but lower part below thallus level; lirellae with gently sloping margins; Fig. 2B); 3) prominent (hymenium fully above thallus level; lirellae with steeply sloping margins; Fig. 2C & D); 4) sessile (lirellae basally constricted; Fig. 2E–F). Variation of lirella emergence on a single thallus depends mostly on age, with the lirellae in most cases starting out as fissures in the thallus. Lirella emergence is best observed in transverse sections of mature lirellae towards the thallus centre under the dissecting microscope or, with some experience, from surface view, using a light source at an angle of 45 degrees (light sources at higher angles will make the lirellae appear flatter than they actually are). For mature lirellae, we accepted a variation range over two states, i.e. immersed to erumpent, erumpent to prominent, and prominent to sessile. For a given species, the degree of lirella emergence given in the key is the state observed in most specimens (>75%); or the actual range is given.

Thalline margin of lirellae. Because of the carbonized excipulum, the labia in *Graphis* species are black. However, in many species they are covered by a thalline margin, leaving only the upper part of the labia exposed or covering them completely (Fig. 3). A thalline margin is absent when the black labia are erumpent to sessile and the black colour reaches down to the thallus level (Fig. 3A); by default, immersed lirellae must have at least a lateral thalline margin. A basal thalline margin is developed when it covers less than half of the overall height of the lirellae (Fig. 3B), whereas a lateral thalline margin usually is at level with the height of the lirellae and only leaves the upper, horizontal part of the labia exposed and black (Fig. 3C & D). Many species have an apically thin complete thalline margin: the lateral part of the thalline margin is thick and contains a photobiont layer, whereas the upper part consists of a thin, hyaline cortex only; in this case the upper part of the labium appears dark grey (Fig. 3E). In species with an apically thick complete thalline margin, the margin is uniformly composed of cortex and photobiont layer up to the top and the black excipulum surface is more or less invisible (Fig. 3F). The nature of the thalline margin varies with age: even in species with eventually prominent lirellae lacking a thalline margin, young lirellae (or the tips of the lirellae) first appear as immersed fissures or narrow black lines with a thalline margin. Thus, the nature of the thalline margin should be observed in mature lirellae towards the centre of the thallus.

Relative length and branching of lirellae. We have identified six different lirellae shape

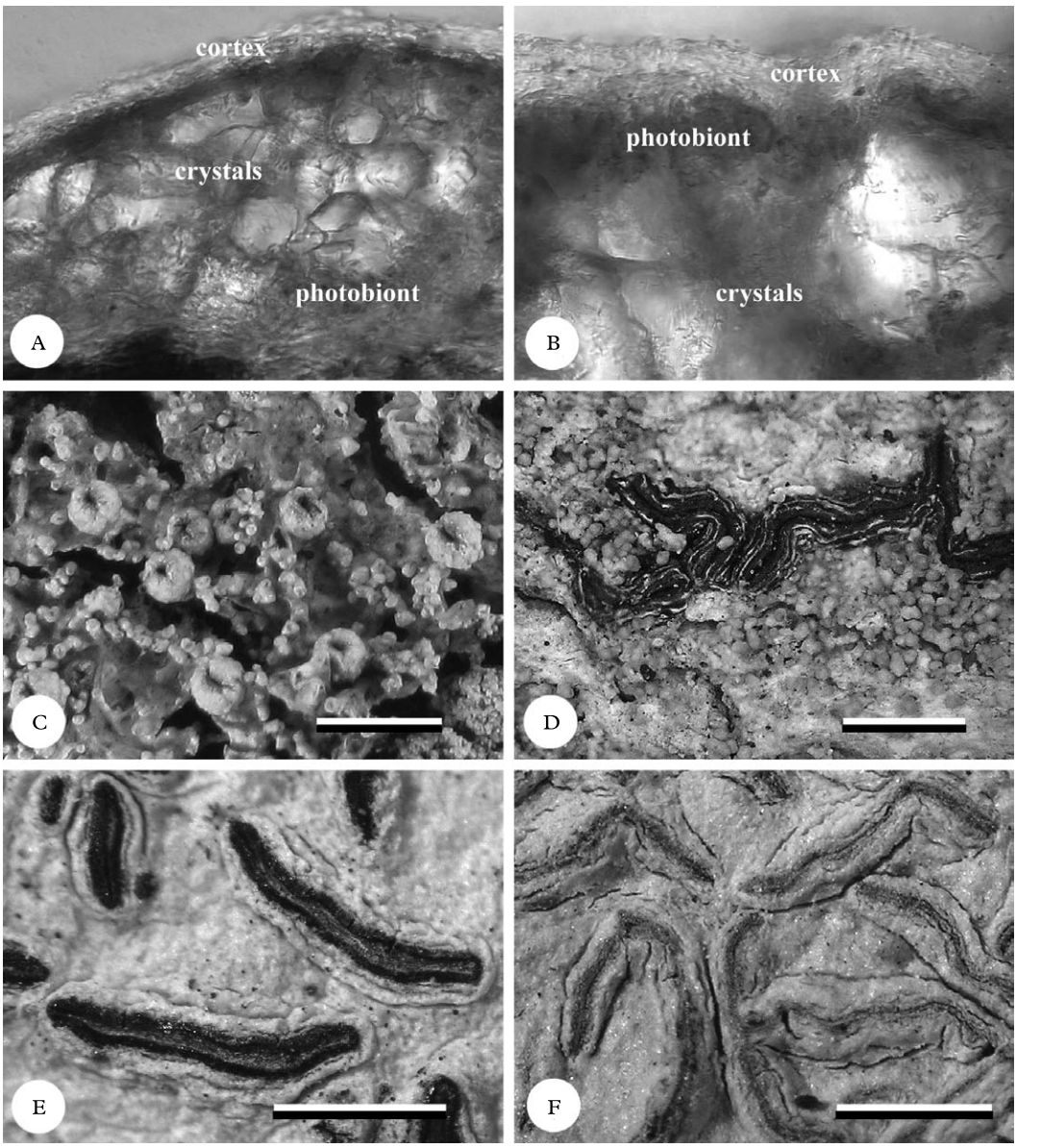

FIG. 1. Morphological and anatomical features in *Graphis*. A, *G. acharii* with photobiont layer below calcium oxalate crystal clusters; B, *G. caribica* with photobiont later above calcium oxalate crystal clusters; C–D, *G. isidiata* and *G. patwardhanii* with isidia; E, *G. crebra* with exposed, pruinose discs; F, *G. caesiella* with pruinose labia. Scale = 1 mm.

patterns, i.e. relative length and branching (Fig. 4): 1) round and unbranched (more or less as long as wide; Fig. 4A), 2) very short and unbranched (up to 2 mm long and 3–10 times as long as wide in the longest lirellae; Fig. 4B), 3) short and sparsely branched (up to 3 mm long and 10–15 times as long as broad in the longest lirellae; Fig. 4C), 4) elongate and irregularly branched (5–10 mm long and 15–30 times as long as broad in the longest lirellae; Fig. 4D), 5) very long and radiately branched (usually over 10 mm long

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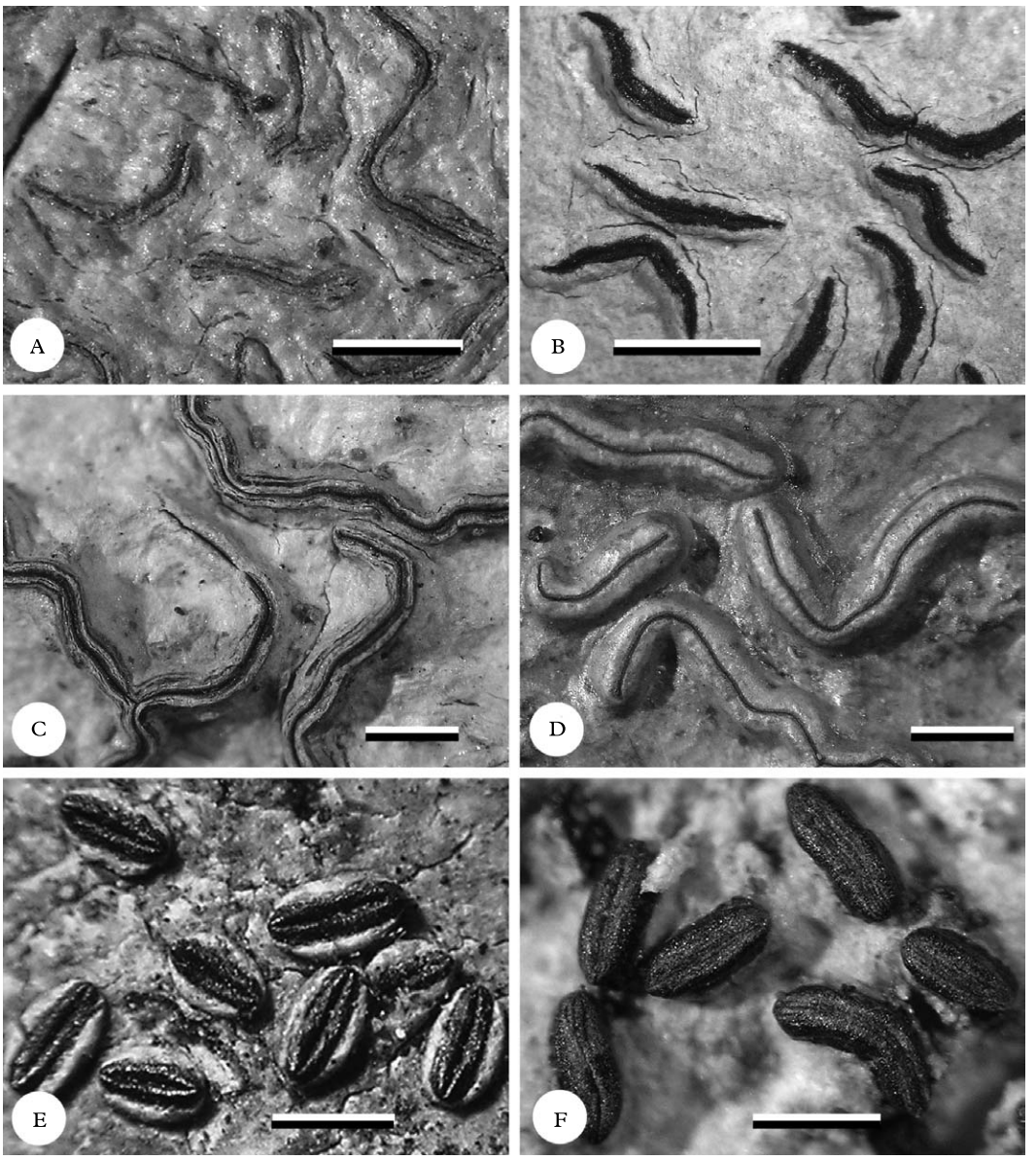

FIG. 2. Morphological and anatomical features in *Graphis*. A, *G. symplecta* with immersed lirellae; B, *G. lineola* with erumpent lirellae; C, *G. vestitoides* with prominent lirellae; D, *G. tumidula* with prominent lirellae; E, *G. plagiocarpa* with sessile lirellae; F, *G. ruiziana* with sessile lirellae. Scale = 1 mm.

and consisting of one or a few lirellae covering most of the thallus; Fig. 4E), and 6) short and stellately branched (usually up to 3 mm long and consisting of several to many clusters of stellately branched lirellae; Fig. 4F). Within a given species, variation usually covers one to two different stages, for example, the lirellae can be short to elongate and sparsely to irregularly branched; however, species with round or very short and unbranched lirellae, as well as those with radiately or stellately branched lirellae, vary very little in lirella

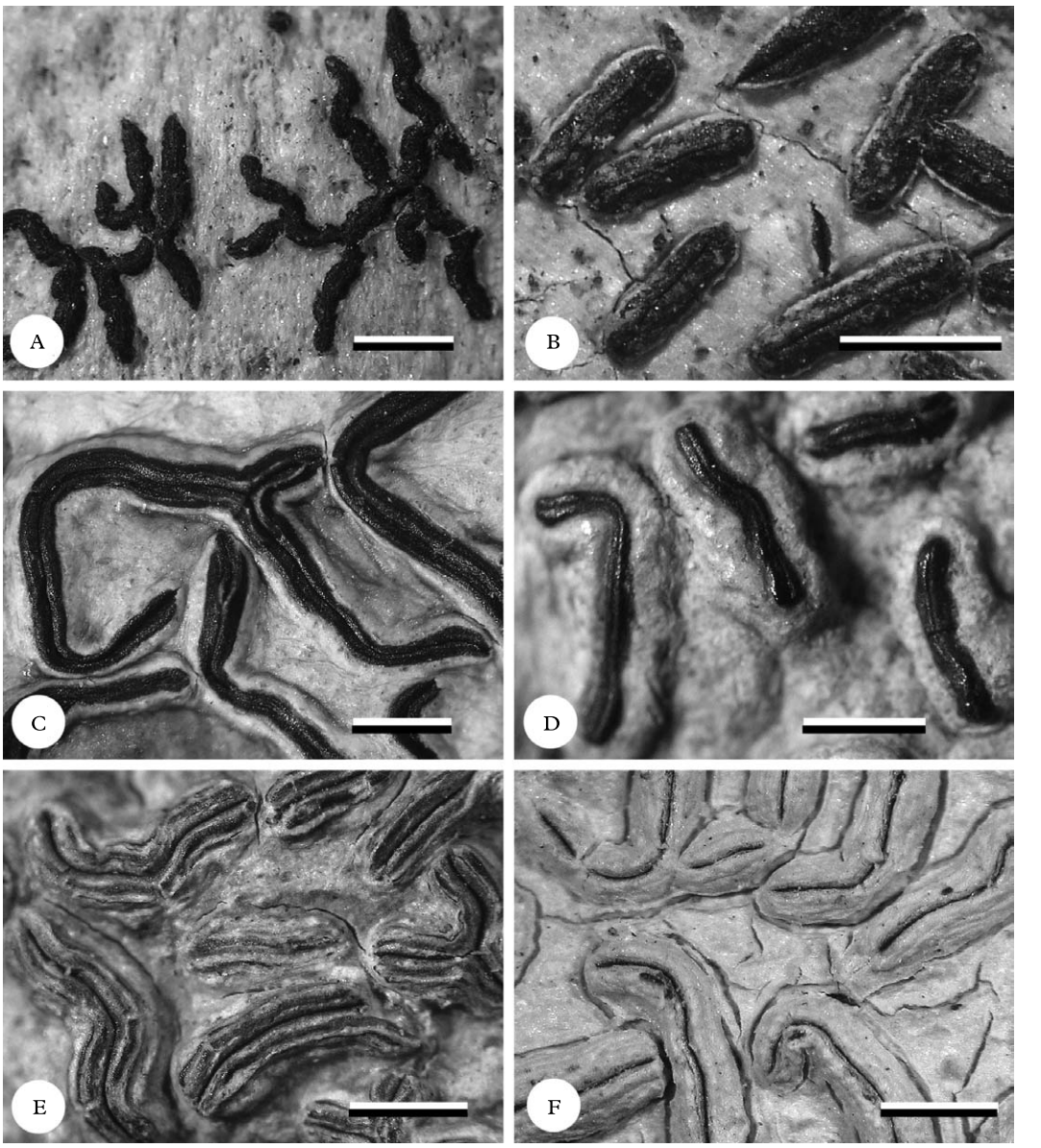

FIG. 3. Morphological and anatomical features in *Graphis*. A, *G. geraensis* lacking a thalline margin; B, *G. consimilis* with a basal thalline margin; C, *G. myrtacea* with a lateral thalline margin; D, *G. flavens* with a thick lateral thalline margin; E, *G. argentata* with an apically thin complete thalline margin; F, *G. illinata* with an apically thick complete thalline margin. Scale = 1 mm.

shape, even in cases where a large number of specimens has been studied (e.g., *G. mexicana, G. ruiziana, G. dendrogramma*). The degree of branching in a given species also varies depending on the group (Lücking 2009, this volume): in species with striate labia lacking a thalline margin (*striatula* group), variation in relative length and branching is much greater than in species with entire labia and lateral thalline margins

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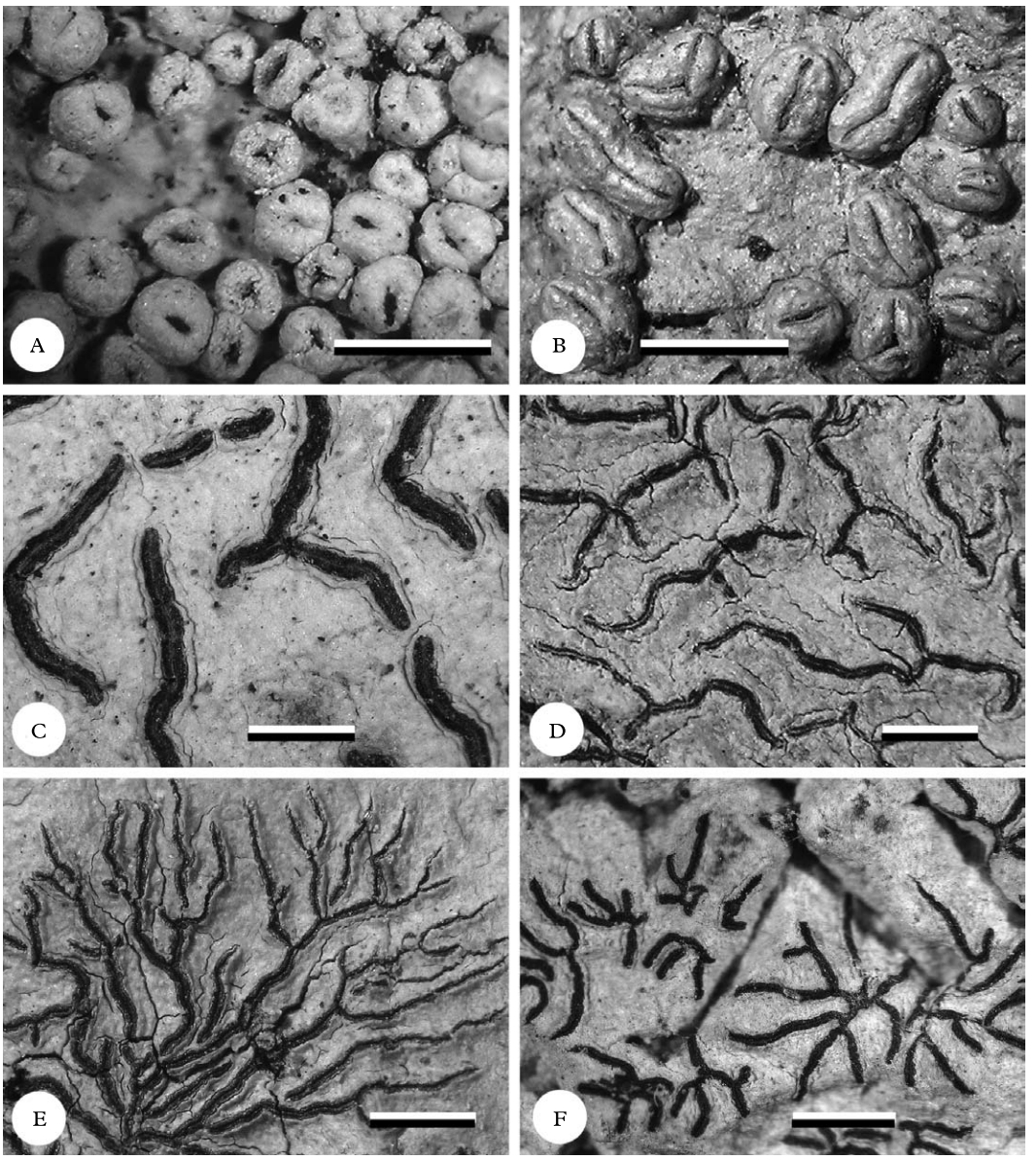

FIG. 4. Morphological and anatomical features in *Graphis*. A, *G. mexicana* with round, unbranched lirellae; B, *G. cleistomma* with very short, unbranched lirellae; C, *G. librata* with short, sparsely branched lirellae; D, *G. furcata* with elongate, irregularly branched lirellae; E, *G. arbusculaeformis* with very long, radiately branched lirellae; F, *G. astrolirellata* with short, stellately branched lirellae. Scale = 1 mm.

(*scripta* and *subserpentina* groups = '*Eugraphis*'), and this is reflected in our species concept.

Disc exposure. Species of *Graphis* often have the disc more or less exposed when fully hydrated, but in dry conditions the disc is concealed. Yet, a few species have an exposed disc even in dry condition (Fig. 1E); these are almost exclusively found in *G. scripta* and relatives, which underlines

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the taxonomic importance of this feature (Lücking 2009, this volume).

Labia and disc pruinosity. Many species exhibit pruinose labia or discs when exposed (Fig. 1E–F). Variation of this character is little understood, but most of the material available indicates that this feature is species specific. The pruina is composed of a layer of crystals and dead hyphal material, differing from the thick pruina characteristic of *Carbacanthographis* and *Dyplolabia*, composed of a layer of hyphae inspersed with crystals or pigment (Staiger 2002) and not found in *Graphis* s. str.

Labium striation. Labium striation (Fig. 5A–B) has been used as an important taxonomic feature in the past (Wirth & Hale 1963, 1978) and was also taken up by Staiger (2002). However, since labium striation seems to be connected to the formation of new hymenia (Staiger 2002), it appears that entire *versus* striate labia represent developmental stages of the same species rather than a taxonomically important character. On the other hand, there are many taxa in which a striate stage is unknown, i.e. they either never form new hymenia or have other strategies to produce new ascospores. Also, there are many striate taxa in which a non-striate stage is unknown and in which even the younger lirellae at the thallus margin are already striate. Thus, while labium striation alone cannot be used to distinguish species, this character clearly is of taxonomic value. Labium striation is best observed in surface view under the dissecting microscope, in combination with a hand-cut section under the compound microscope; in a few species, thin lines of pruina can resemble striation but the excipulum will appear entire in sections.

Excipulum carbonization. *Graphis* is characterized by a partially to completely carbonized excipulum (Fig. 5C–F). Following Redinger (1935) and Wirth & Hale (1963, 1978), Staiger (2002) distinguished several groups characterized by their degree of excipulum carbonization. It is not yet well-understood whether the thick carbonized basal excipulum in certain species of *Graphis* is homologous with the excipulum in other genera or, at least in part, represents a carbonized hypothecium, as in *Leiorreuma*, *Sarcographa*, and *Thecaria* (Staiger 2002). The best way to assess excipulum carbonization is by the observation of hand-cut sections under the dissecting microscope at a high magnification against a white background. Particularly in species of the *striatula* group, the laterally carbonized excipulum may converge basally to appear almost complete; in these cases, one should inspect several mature lirellae and opt for completely carbonized only if the excipulum is clearly contiguous basally in the majority of the sections.

Hymenium inspersion. Hymenium inspersion is another character that was rarely used in the taxonomy of *Graphis*, but turned out to be relevant at the species level (Staiger 2002; Lücking *et al.* 2008; Lücking 2009, this volume). The importance of this character is underlined by the fact that two different types of inspersion occur within the genus and that these types are largely restricted to three species groups. Several species related to *G. scripta* and *G. insulana* have hymenia inspersed with scattered, small oil droplets lining the paraphyses that more or less persist in KOH but do not obstruct the view of asci and ascospores (type A; Fig. 6A). Other species, related to *G. acharii*, have a strong and dense hymenial inspersion of larger, irregular droplets completely obstructing the view of asci and ascospores but easily dissolving in KOH (type B; Fig. 6B).

Ascospores. Species of *Graphis* typically have hyaline, I+ violet-blue, distoseptate ascospores with lens-shaped lumina (Fig. 6C). The iodine reaction is concentrated in the endospore and usually strong, giving a violet-blue to violet-brown colour (Staiger 2002), except at the tips where the lumina tend to be smaller with less endospore. In a few species (e.g., *G. chrysocarpa*, *G. mucronata*, *G. pittieri*), the ascospores become grey-brown. Some variation is found in the degree of the endospore thickenings, especially in taxa with muriform ascospores (Fig. 6D). 'Biocellate' ascospores, such as in *G. vestitoides*, are transversely septate in the middle but muriform at both ends (Fig. 6E). Correlation with other characters, as well as examination of ascospore ontogeny in species with muriform

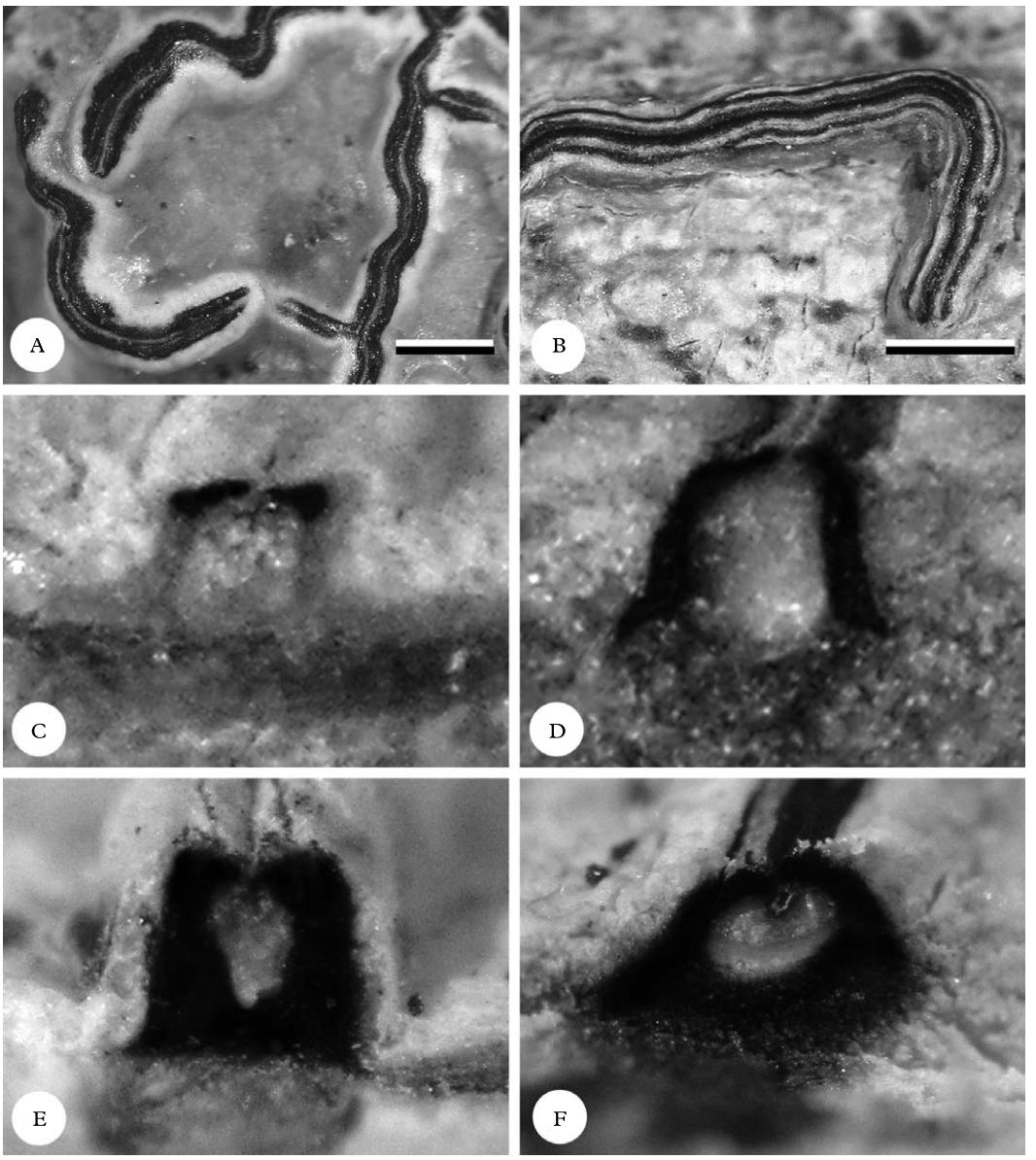

FIG. 5. Morphological and anatomical features in *Graphis*. A, *G. rustica* with entire labia; B, *G. angustata* with striate labia; C, *G. glaucescens* with an apically carbonized excipulum; D. *G. pavoniana* with a laterally carbonized excipulum; E, *G. rhizocola* with a completely carbonized excipulum; F. *G. gomezii* with a completely carbonized excipulum (basal part of excipulum merged with substratum). Scale = 1 mm.

ascospores (which do not feature a terminally muriform stage), show that terminally muriform ascospores do not represent an ontogenetic stage but are species-specific. Many taxa feature gelatinous sheaths or caps (Fig. 6E), but this character has been little explored and depends on the age of the specimen and how it was preserved. Thick-walled ascospores are found in *G. elegans* and a few other species (Fig. 6F).

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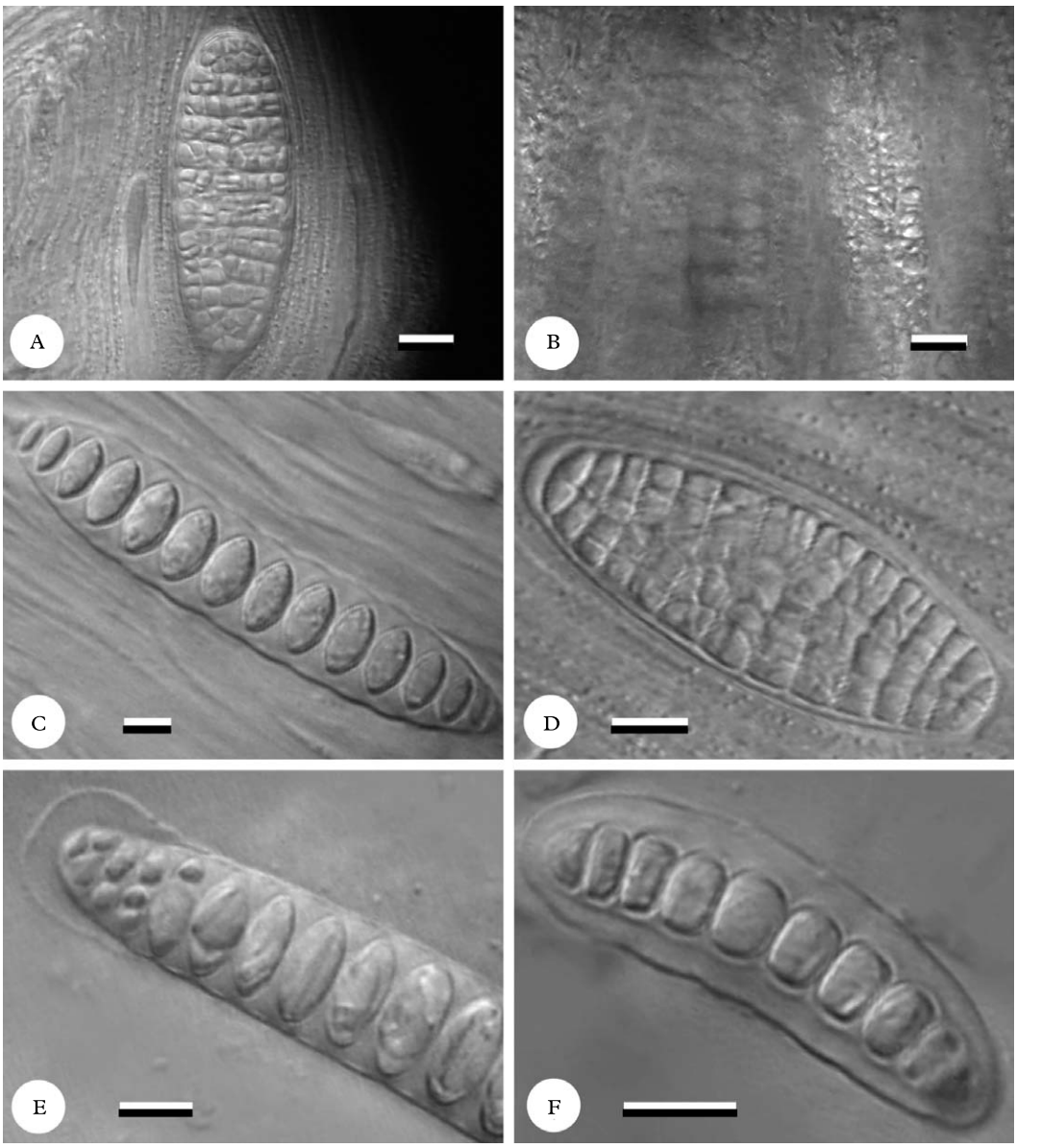

FIG. 6. Morphological and anatomical features in *Graphis*. A, *G. insulana* with type A inspersion (asci and ascospores easily visible); B. *G. argentata* with type B inspersion (asci and ascospores barely visible); C, *G. rhizocola* with ascospores with lens-shaped lumina; D. *G. insulana* with ascospores with nearly rectangular lumina; E, *G. vestitoides* with biocellate ascospore (terminally muriform) and gelatinous caps; F, *G. elegans* with thick-walled ascospores. Scale = 10 μm.

For proper interpretation of ascospore characters, care should be taken to exclude taxonomically uninformative infraspecific and ontogenetic variation. Character states change during ascospore development, for which endospore development is a good indicator: in young ascospores, the endospore is thin and the iodine reaction weak. Mature

ascospores are often (slightly) constricted at the septa, while young ascopores are not. In old, post-mature ascospores, the endospore disintegrates and the iodine reaction disappears, and often the ascospores shrivel. The number of ascospores per ascus should be carefully assessed observing several asci from different lirellae. Ascopores are often discharged prematurely or their number is difficult to assess within the ascus. If there are more than four ascospores per ascus, the actual number is most probably eight.

Ascospore size and its taxonomic relevance is a particularly difficult character. Based on the study of indivdual thalli, as well as size variation in well-delimited species, we have generally accepted a size range of about 100%, i.e. the upper limit being about twice as large as the lower limit (e.g., 25–50 µm, 50–100 µm, 100–200 µm). Species with otherwise identical characters but different ascospores, so-called sporomorphs (Wirth & Hale 1978) occur frequently in *Graphis*. Analysis of hundreds of species and thousands of specimens revealed certain preferred ascospore size classes, i.e. size ranges that occur more frequently than others: very small (15–25 µm), small (25–45 µm; most ascospores 30–40 µm), medium (45–80 µm; most ascospores 50–70 µm), large (80–150 µm; most ascospores 100–130 µm), and very large (150–300 µm; most ascospores 180–250 µm). Ascospore size should be measured in mature ascospores only, i.e. with the endospore fully developed, and to assess size range, one should measure at least ten ascospores in a given specimen, from different asci and preferably from different lirellae. In species with a variable number of ascospores per ascus, ascospore size might vary more than usual and one should refer to the larger ascospores unless asci with few, large ascospores are an exception in a specimen. Ascospore size should be measured in water; KOH will result in an increase of size ranges by more or less 10–20%.

Secondary chemistry. Most species of *Graphis* lack secondary substances (Staiger 2002; Archer 2006; Lücking *et al.*, 2008; Lücking 2009, this volume). Species with a simple chemistry with norstictic or stictic acids and accessory substances are particularly common in relatives of *G. scripta* and *G. insulana* ('*Eugraphis*'). Salazinic and protocetraric acids are comparatively rare. A few species, especially from the Indian subcontinent, have a combination of up to three of these acids. The concentration of such species in India, also seen in the related genus *Hemithecium* (Adawadkar & Makhija 2005; Makhija *et al.* 2005*a*, *b*), does not appear to be an artifact, as we have seen authentic TLC plates of some of these species, but might reflect a peculiarity of the evolution and palaeogeography of *Graphis* and relatives. Lichexanthone is found in less than a handful of taxa. Yellow to orange anthraquinones are restricted to a few species and usually occur as pruina on the surface of the labia. Isohypocrelline, a dark red, K+ green perlene quinone widespread within the family, has so far been found only in two species of *Graphis*.

Secondary substances in *Graphis* are identified either by TLC or spot tests. Most users are familiar with TLC and spot test techniques to routinely identify lichen substances (e.g., Walker & James 1980; Lumbsch 2002), but in crustose lichens the reliable application of spot tests is more difficult and there are contradictions as to colour reactions in the literature. Unfortunately, certain rare substances such as hirtifructic and hypostictic acid cannot be identified by spot tests, and TLC is needed in doubtful cases. TLC is also necessary in material or groups (e.g., *G. scripta* and *G. insulana* groups) that may contain more than one major substance, especially if collected in the Eastern Palaeotropics. Microchemical reactions should be performed under the microscope on hand-cut sections of thallus and lirellae using a 10–20% KOH solution (to test for the presence of norstictic, salazinic, or stictic acid) and under the dissecting microscope using Steiner's PD solution (to test for the presence of protocetraric acid). A persistently pale to bright yellow efflux without formation of crystals indicates stictic acid, whereas a bright yellow efflux eventually producing red, needle-shaped crystals (immediately or up to 60 seconds later) indicates norstictic (large

crystals) or salazinic acid (small crystals). In some cases, the bark substratum reacts with a yellow efflux to KOH, but the colour is more orange-yellow and only appears on the lower (bark) side of the thallus; with some experience, the characteristic stictic-yellow can be readily recognized.

Lirellae morphs. In order to facilitate recognition of lirella morphology, a number of different lirella morphs have been defined that combine lirella emergence, thalline margin, relative length, and branching (Lücking 2009; this volume). In addition to anatomical and chemical characters, one should use the key to morphs below and compare a given specimen to these morphs (Fig. 7–12) before entering the main key.

1	Lirellae lacking thalline margin or with basal thalline margin only	2
	Lirellae with lateral to complete thalline margin	11
2 (1)	Labia entire	3
	Labia striate	7
3 (2)	Lirellae very short and unbranched	4
	Lirellae short to elongate and sparsely to irregularly or stellately to radiately branched	5
4 (3)	Lirellae erumpent	***subregularis*-morph** (Fig. 7A)
	Lirellae prominent to sessile	***nuda*-morph** (Fig. 7C)
5 (3)	Lirellae prominent to sessile, radiately branched	***slendrae*-morph**
	Lirellae erumpent to prominent, sparsely to irregularly or stellately branched	6
6 (5)	Lirellae stellately branched	***geraensis*-morph** (Fig. 7B)
	Lirellae sparsely to irregularly branched.	***hossei*-morph** (Fig. 7D)
7 (2)	Lirellae with yellow or orange pruina	***chrysocarpa*-morph**
	Lirellae lacking (pigmented) pruina	8
8 (7)	Lirellae very short and unbranched, prominent to sessile	***granulocarpa*-morph** (Fig. 7E)
	Lirellae short to very long and sparsely to radiately branched, erumpent to prominent	9
9 (8)	Lirellae sparsely to irregularly branched, erumpent to prominent	***striatula*-morph** (Fig. 7F)
	Lirellae radiately or stellately branched, erumpent	10
10 (9)	Lirellae short, stellately branched	***hunanensis*-morph**
	Lirellae elongate to very long, radiately branched	***sorediosa*-morph**
11 (1)	Lirellae with lateral thalline margin (upper part of labia black)	12
	Lirellae with complete thalline margin (upper part of labia dark grey or invisible)	33
12 (11)	Labia entire	13
	Labia striate	28
13 (12)	Lirellae immersed to erumpent	14
	Lirellae prominent to sessile	25
14 (13)	Disc exposed	15
	Disc concealed	16

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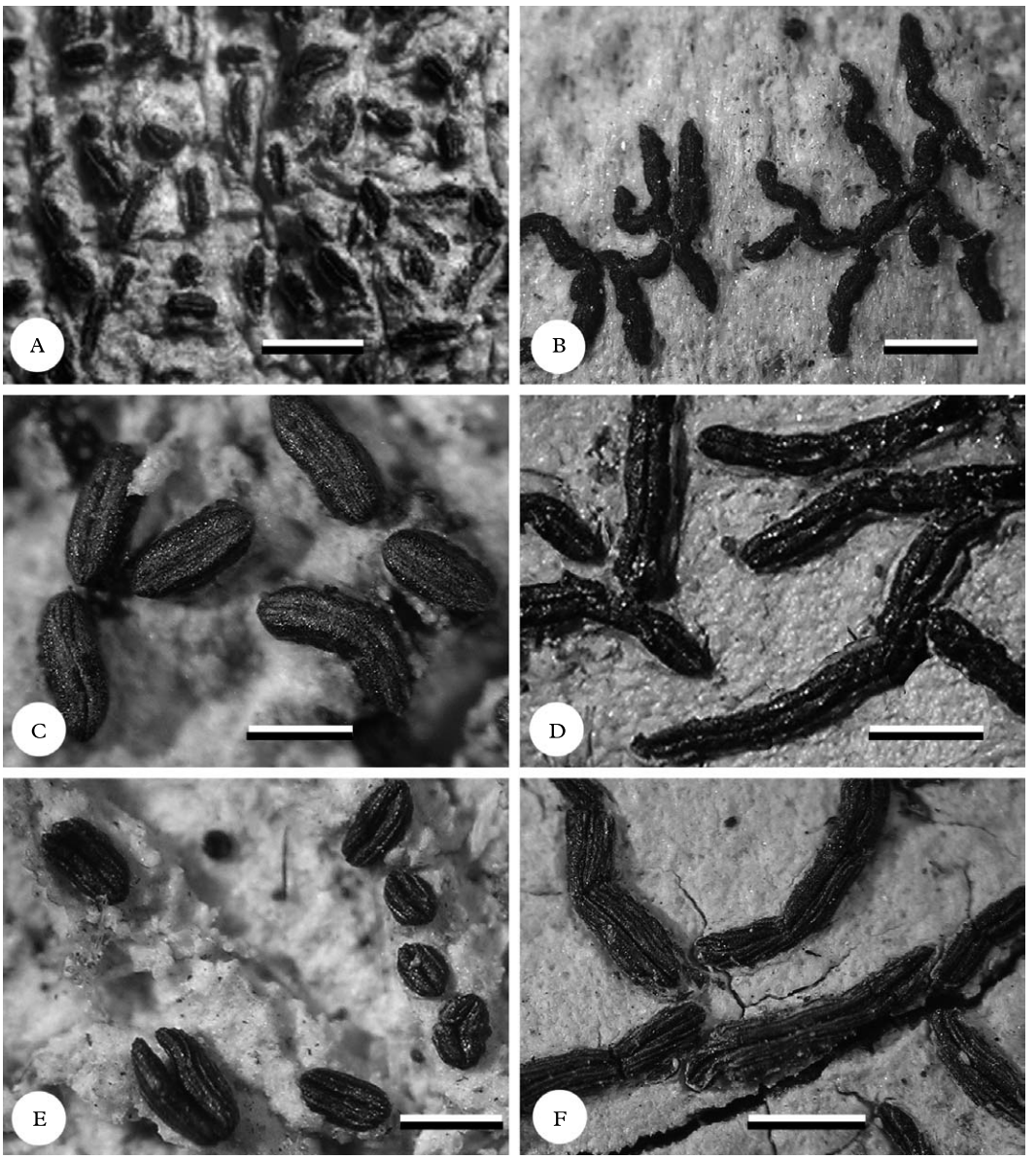

FIG. 7. Lirella morphs in *Graphis*. A, *subregularis*-morph (*G. subregularis*); B, *geraensis*-morph (*G. geraensis*); C, *nuda*-morph (*G. ruiziana*); D, *hossei*-morph (*G. analoga*); E, *granulocarpa*-morph (*G. granulocarpa*); F, *striatula*-morph (*G. striatula*). Scale = 1 mm.

15 (14) Disc pruinose . . . . . ***scripta*-morph** (Fig. 8F)
Disc non-pruinose . . . . . ***handelii*-morph** (Fig. 8E)

16 (14) Labia pruinose 17
Labia non-pruinose 20

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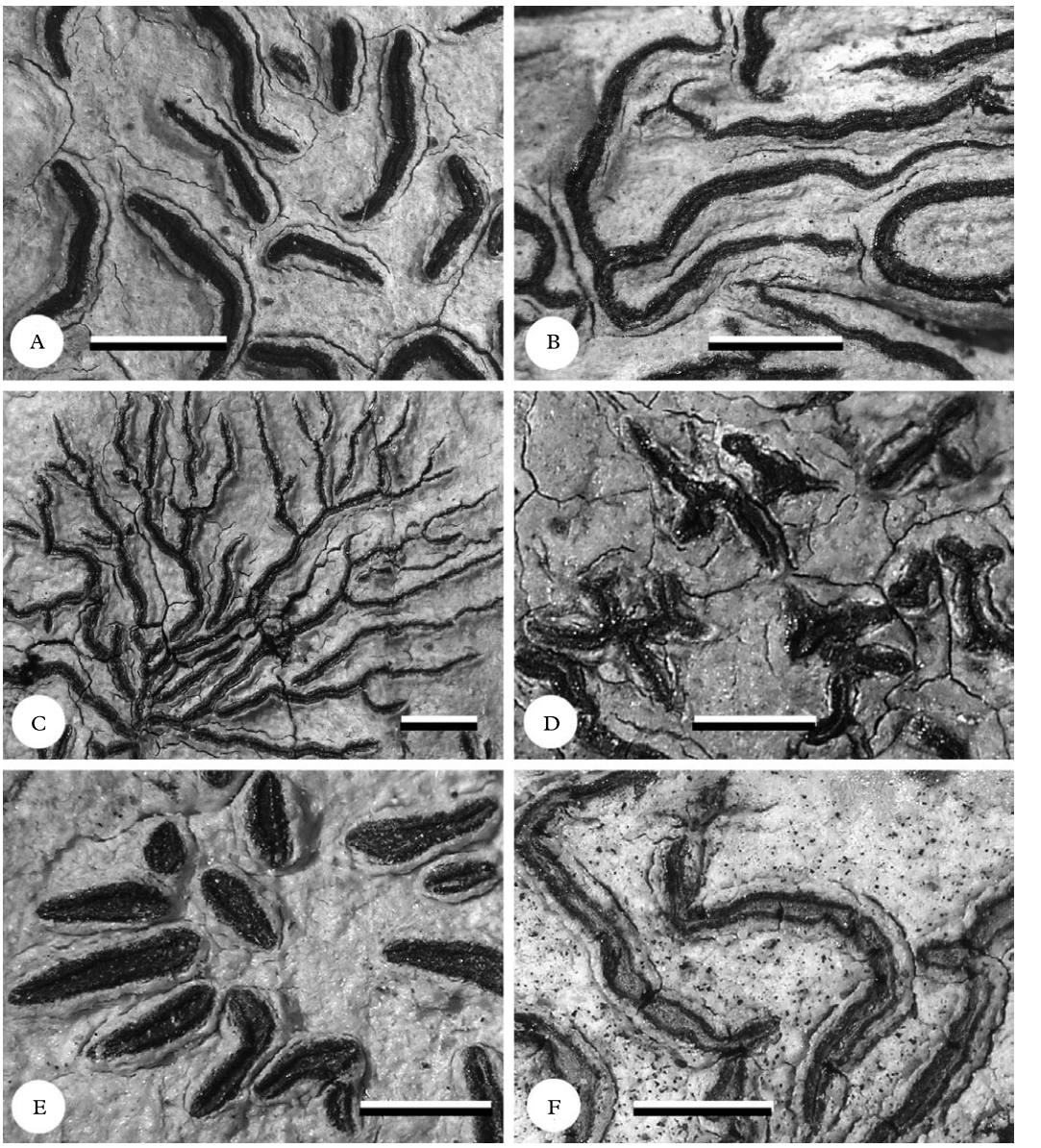

FIG. 8. Lirella morphs in *Graphis*. A, *lineola*-morph (*G. lineola*); B, *deserpens*-morph (*G. deserpens*); C, *centrifuga*-morph (*G. arbusculaeformis*); D, *coarctata*-morph (*G. cervinonigra*); E, *handelii*-morph (*G. handelii*); F, *scripta*-morph (*G. scripta*). Scale = 1 mm.

17 (16) Lirellae radiately or stellately branched 18
Lirellae sparsely to irregularly branched. 19

18 (17) Lirellae very long and radiately branched . . . ***dendrogramma*-morph** (Fig. 9B)
Lirellae short and stellately branched . . . . . ***hyphosa*-morph** (Fig. 9C)

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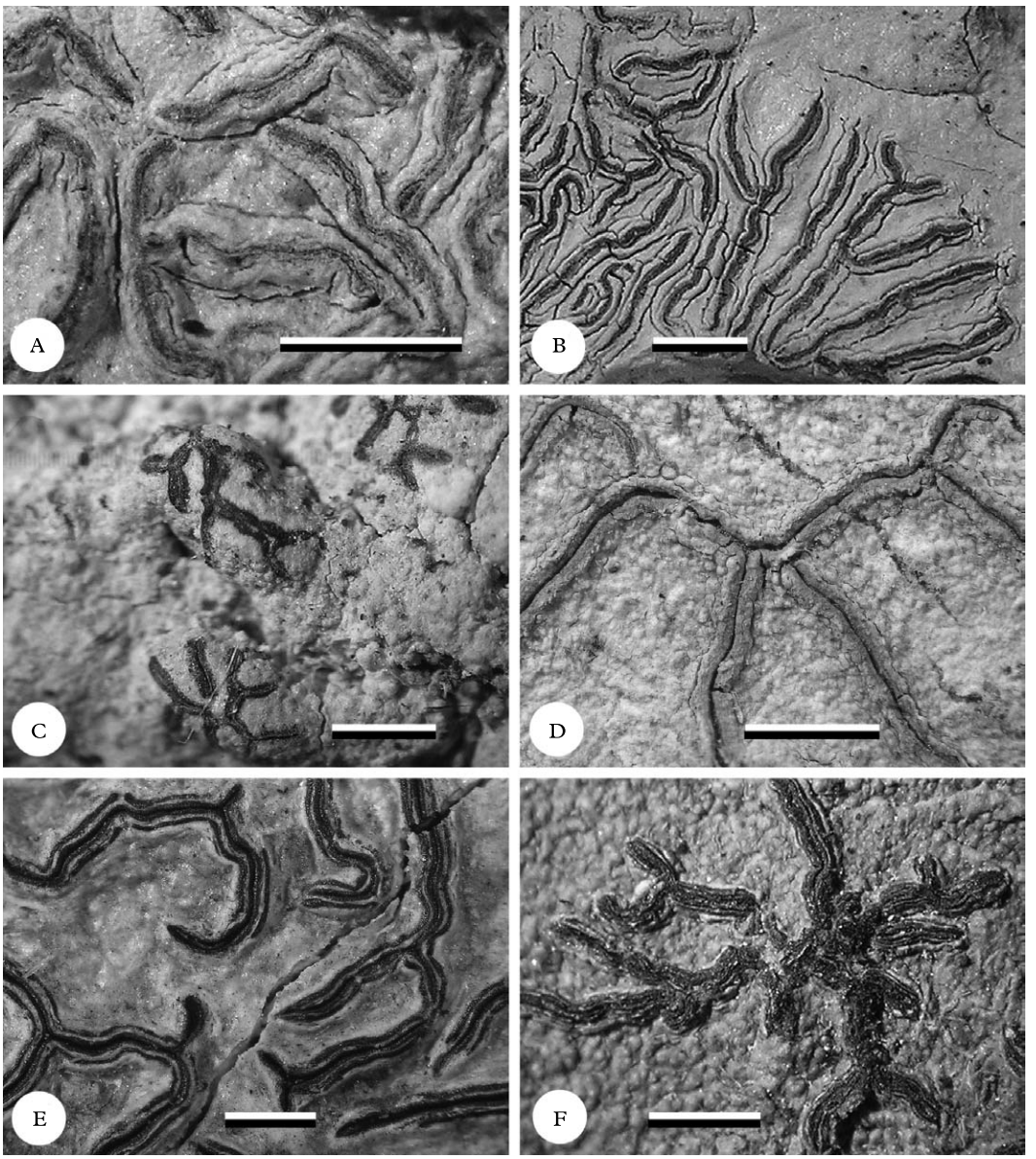

FIG. 9. Lirella morphs in *Graphis*. A, *caesiella*-morph (*G. caesiella*); B, *dendrogramma*-morph (*G. dendrogramma*); C, *hyphosa*-morph (*G. hyphosa*); D, *glaucescens*-morph (*G. glaucescens*); E, *tenella*-morph (*G. myrtacea*); F, *asterizans*-morph (*G. asterizans*). Scale = 1 mm.

19 (17) Thallus ecorticate . . . . . ***glaucescens*-morph** (Fig. 9D)
Thallus corticate . . . . . ***caesiella*-morph** (Fig. 9A)

20 (16) Thalline margin thick, bulging 21
Thalline margin thin, not bulging 22

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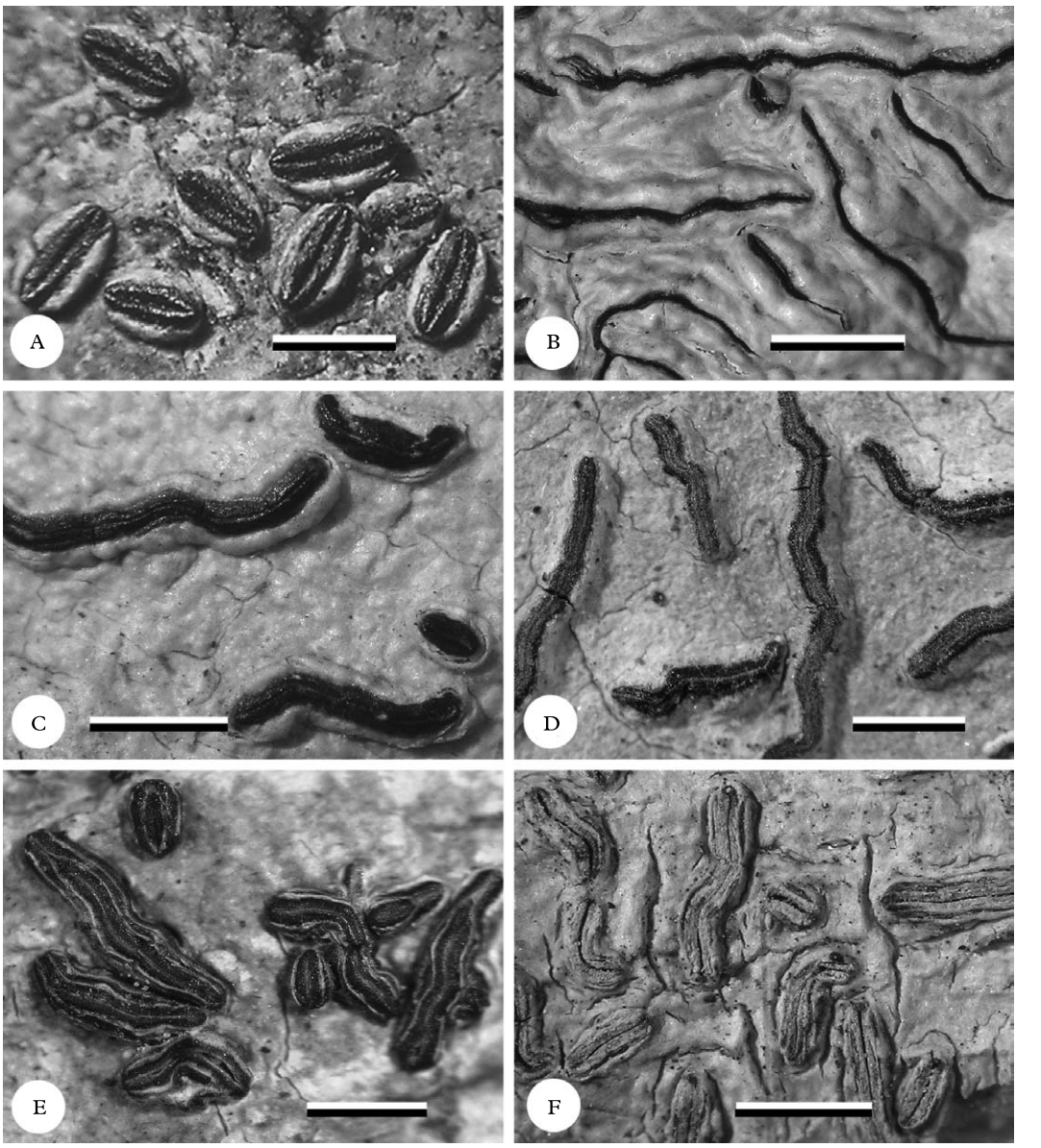

FIG. 10. Lirella morphs in *Graphis*. A, *dussii*-morph (*G. plagiocarpa*); B, *subserpentina*-morph (*G. japonica*); C, *marginata*-morph (*G. rustica*); D. *farinulenta*-morph (*G. farinulenta*); E, *lumbricina*-morph (*G. lumbricina*); F, *albotecta*-morph (*G. albotecta*). Scale = 1 mm.

21 (20) Lirellae very long, radiately branched, disc slightly exposed . ***longiramea*-morph**
Lirellae short to elongate and sparsely to irregularly branched, disc concealed . . . . . ***subserpentina*-morph** (Fig. 10B)

22 (20) Lirellae radiately or stellately branched 23
Lirellae sparsely to irregularly branched. **24**

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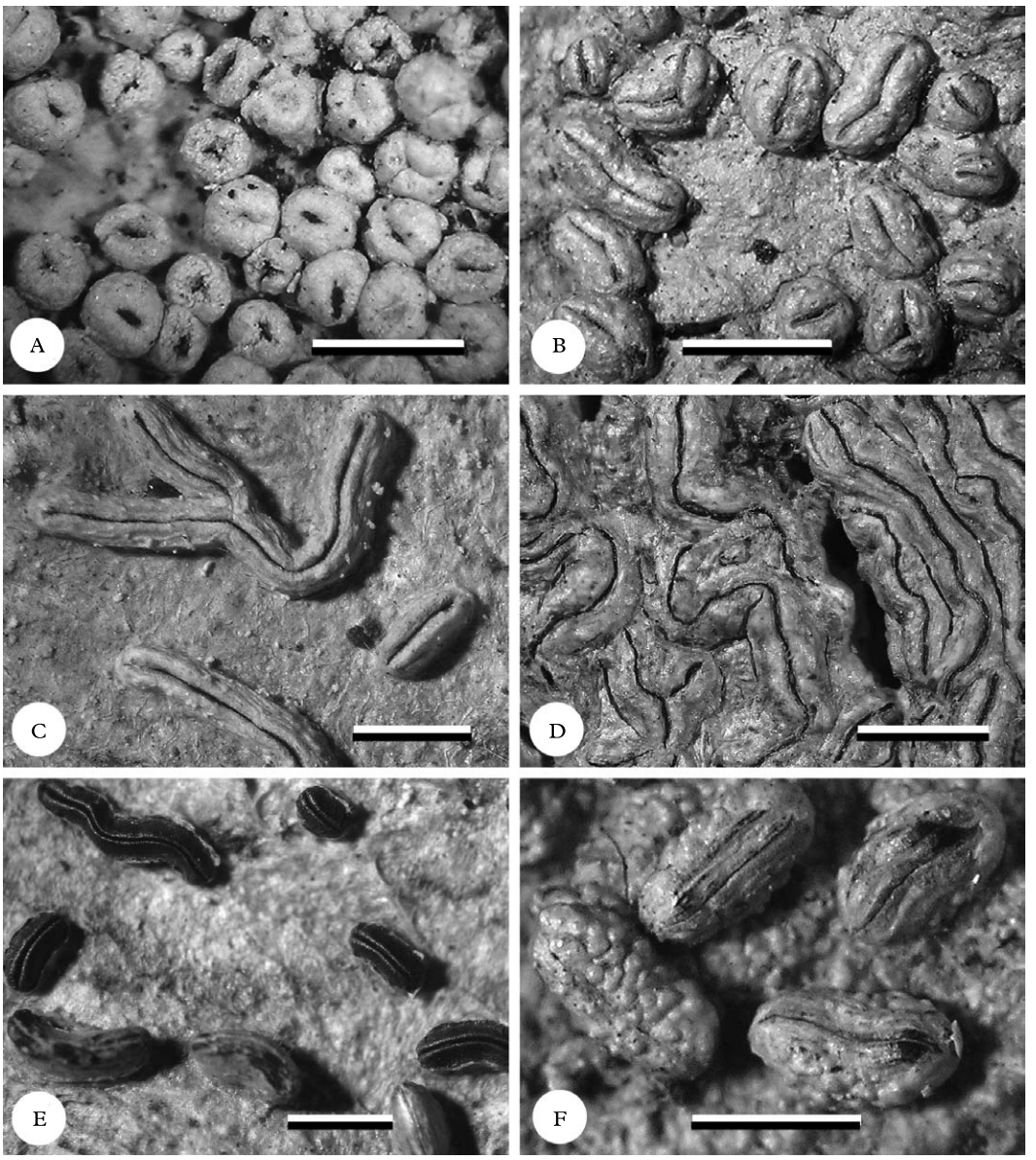

FIG. 11. Lirella morphs in *Graphis*. A, *globosa*-morph (*G. mexicana*); B, *cleistomma*-morph (*G. cleistomma*); C, *illinata*-morph (*G. illinata*); D, *consanguinea*-morph (*G. consanguinea*); E, *nudaeformis*-morph (*G. nudaeformis*); F, *granulosa*-morph (*G. granulosa*). Scale = 1 mm.

23 (22) Lirellae very long and radiately branched . . . . . ***centrifuga*-morph** (Fig. 8C)
Lirellae short and stellately branched . . . . . .***coarctata*-morph** (Fig. 8D)

24 (22) Lirellae short and sparsely branched . . . . . .***lineola*-morph** (Fig. 8A)
Lirellae elongate and irregularly branched . . . . . .***deserpens*-morph** (Fig. 8B)

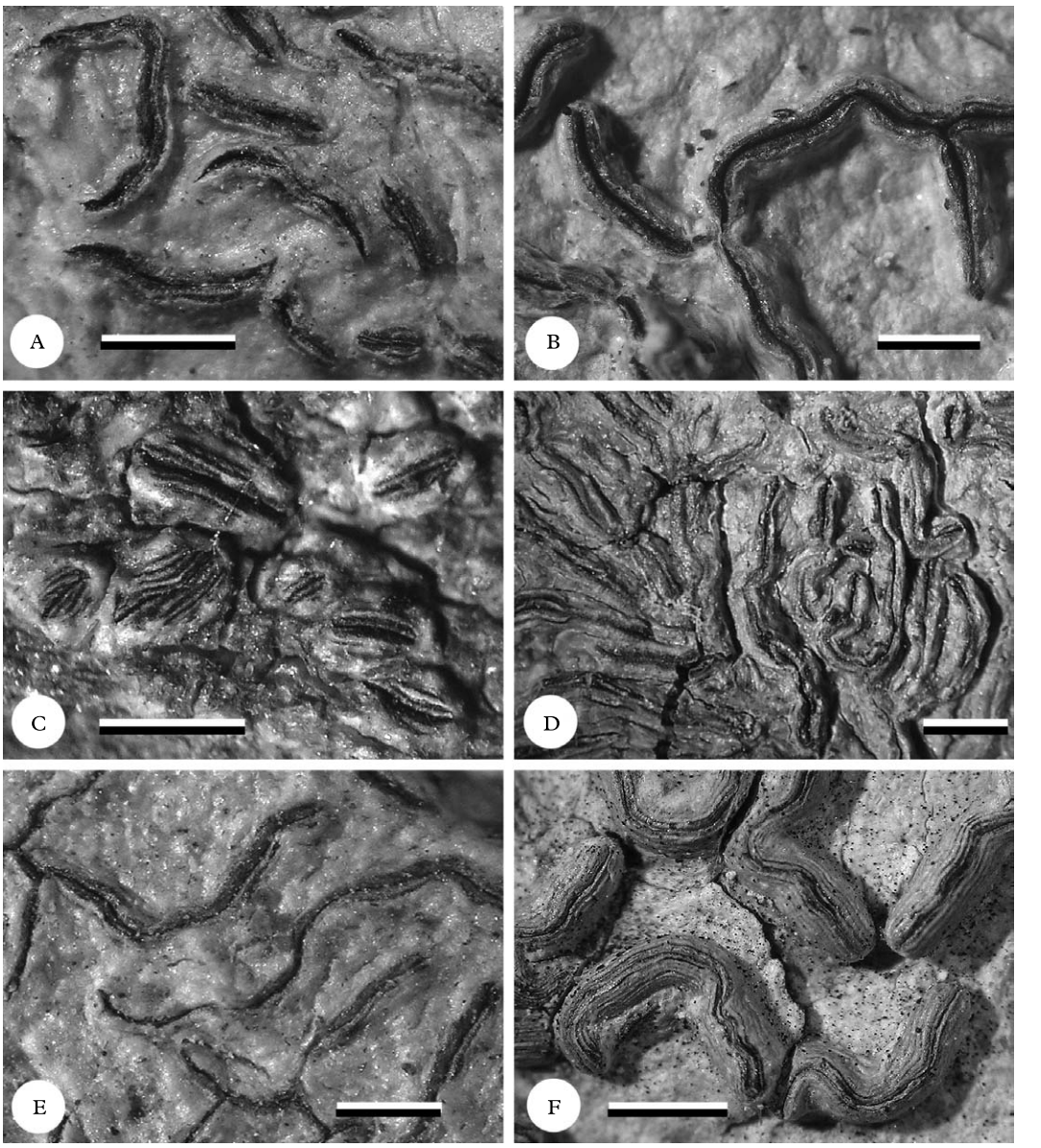

FIG. 12. Lirella morphs in *Graphis*. A, *negrosina*-morph (*G. negrosina*); B, *rhizocola*-morph (*G. rhizocola*); C, *multisulcata*-morph (*G. multisulcata*); D, *subradiata*-morph (*G. subradiata*); E, *symplecta*-morph (*G. symplecta*); F, *acharii*-morph (*G. acharii*). Scale = 1 mm.

25 (13) Lirellae stellately branched, lateral margin thin . . . . . ***stellata*-morph**
Lirellae unbranched to irregularly branched, lateral margin usually thick 26

26 (26) Labia pruinose . . . . . ***farinulenta*-morph** (Fig. 10D)
Labia non-pruinose 27

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27 (26) Lirellae very short and unbranched, usually sessile . . . ***dussii*-morph** (Fig. 10A)
Lirellae short to elongate and sparsely to irregularly branched, usually prominent . . . . . ***marginata*-morph** (Fig. 10C)

28 (12) Lirellae prominent 29
Lirellae immersed to erumpent 30

29 (28) Lirellae stellately branched . . . . . ***asterizans*-morph** (Fig. 9F)
Lirellae sparsely to irregularly branched. . . . . ***celata*-morph**

30 (28) Labia pruinose 31
Labia non-pruinose 32

31 (30) Thallus ecorticate . . . . . ***glaucescens*-morph**
Thallus corticate . . . . . ***chloroalba*-morph**

32 (30) Lirellae very long and radiately branched . . . . . ***dichotoma*-morph**
Lirellae short to elongate and sparsely to irregularly branched . . . . . ***tenella*-morph** (Fig. 9E)

33 (11) Labia entire 34
Labia striate 42

34 (33) Lirellae round to very short, unbranched 35
Lirellae short to very long, sparsely to radiately branched 36

35 (34) Lirellae round . . . . . ***globosa*-morph** (Fig. 11A)
Lirellae very short . . . . . ***cleistomma*-morph** (Fig. 11B)

36 (34) Lirellae radiately or stellately branched 37
Lirellae sparsely to irregularly branched. 38

37 (36) Lirellae very long and radiately branched . . . . . ***anguilliradians*-morph**
Lirellae short and stellately branched . . . . . ***evirescens*-morph**

38 (36) Lirellae sessile, thalline margin partly flaking off . . . . . ***nudaeformis*-morph** (Fig. 11E)
Lirellae erumpent to prominent, thalline margin persistent 39

39 (38) Thalline margin apically thin (upper part of labia dark grey). 40
Thalline margin apically thick (labia more or less invisible) 41

40 (39) Lirellae erumpent . . . . . ***negrosina*-morph** (Fig. 12A)
Lirellae prominent . . . . . ***rhizocola*-morph** (Fig. 12B)

41 (39) Lirellae erumpent . . . . . ***subserpentina*-morph** (Fig. 10B)
Lirellae prominent . . . . . ***illinata*-morph** (Fig. 11C)

42 (33) Lirellae radiately branched . . . . . ***subradiata*-morph** (Fig. 12D)
Lirellae unbranched to irregularly branched 43

43 (42) Lirellae very short, unbranched 44
Lirellae short to elongate, sparsely to irregularly branched 45

44 (43) Thalline margin apically thin (upper part of labia dark grey). . . . . ***multisulcata*-morph** (Fig. 12C)
Thalline margin apically thick (labia more or less invisible) . . . . . ***granulosa*-morph** (Fig. 11F)

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45 (43) Labia pruinose . . . . . ***albotecta*-morph** (Fig. 10F)
Labia non-pruinose 46

46 (45) Thalline margin apically thick (labia more or less invisible), lirellae immersed to erumpent . . . . . ***consanguinea*-morph** (Fig. 11D)
Thalline margin apically thin (upper part of labia dark grey), lirellae immersed to prominent 47

47 (46) Lirellae immersed to erumpent . . . . . ***symplecta*-morph** (Fig. 12E)
Lirellae prominent 48

48 (47) Thalline margin partly flaking off . . . . . ***lumbricina*-morph** (Fig. 10E)
Thalline margin persistent . . . . . ***acharii*-morph** (Fig. 12F)

Genera likely to be confused with *Graphis*

The following key helps to separate genera with carbonized excipulum and well-developed labia from *Graphis* s.str. We have also mentioned species of genera with hyaline ascospores likely to be confused with *Graphis* under the corresponding key couplets of the *Graphis* keys.

1 Ascospores hyaline 2
Ascospores grey-brown 6

2 (1) Labia white pruinose, C+ red (lecanoric acid) . . . . . **Dyplolabia**
Labia non-pruinose or pruinose but C–. 3

3 (2) Ascospores I–; labia usually thickly white or pale yellow pruinose; warty periphysoids above the hymenium usually present . . . . . **Carbacanthographis**
Ascospores I+ violet-blue; ascomata non-pruinose or thinly white or brown pruinose; warty periphysoids absent 4

4 (3) Lirellae brown pruinose . . . . . **Glyphis**
Lirellae non-pruinose or (thinly) white pruinose 5

5 (4) Thallus ecorticate, with diverse secondary chemistry (stictic, norstictic, salazinic, and/or protocetraric acid and/or lichexanthone); lirellae with distinctly white-pruinose labia and partially exposed, white-pruinose disc; paraphyses apically anastomosing; ascospores muriform . . . . . **Diorygma**
Thallus corticate (if ecorticate then lacking secondary substances or rarely norstictic acid and ascospores transversely septate); lirellae non-pruinose or thinly white-pruinose but not with both labia and exposed disc thickly white-pruinose; paraphyses unbranched or rarely apically branched but not anastomosing; ascospores variable. . . . . **Graphis**

6 (1) Disc exposed . . . . . **Platygramme**
Disc concealed 7

7 (6) Thallus white-grey; hymenium clear or rarely inspersed; ascospores I+ violet-blue . . . . . **Graphis**
Thallus olive-green; hymenium inspersed; ascospores I+ vine-red. 8

8 (7) Lirellae sessile, lacking thalline margin; excipulum completely carbonized . . . . . **Thecographa**
Lirellae erumpent to prominent, with lateral to complete thalline margin; excipulum apically to laterally carbonized . . . . . **Platygramme**

TABLE 1. *Tabular key to main groups of species of* Graphis.

Pigment	Striation	Carbonization	Inspersion	Ascospores	Group
yellow-orange-red	(variable)	(variable)	(variable)	(variable)	Group 1
absent	entire	apical(-peripheral)	clear	transverse	Group 2
absent	entire	apical(-peripheral)	clear	muriform	Group 3
absent	entire	apical(-peripheral)	inspersed	transverse	(no species)
absent	entire	apical(-peripheral)	inspersed	muriform	*Graphis pertricosa*
absent	entire	lateral	clear	transverse	Group 4
absent	entire	lateral	clear	muriform	Group 5
absent	entire	lateral	inspersed	transverse	Group 6
absent	entire	lateral	inspersed	muriform	Group 7
absent	entire	complete	clear	transverse	Group 8
absent	entire	complete	clear	muriform	Group 9
absent	entire	complete	inspersed	transverse	Group 10
absent	entire	complete	inspersed	muriform	Group 11
absent	striate	apical and basal	clear	(variable)	Group 12
absent	striate	apical(-peripheral)	clear	transverse	Group 13
absent	striate	apical(-peripheral)	clear	muriform	Group 14
absent	striate	apical(-peripheral)	inspersed	transverse	*Graphis nigroglauca*
absent	striate	apical(-peripheral)	inspersed	muriform	(no species)
absent	striate	lateral	clear	transverse	Group 15
absent	striate	lateral	clear	muriform	Group 16
absent	striate	lateral	inspersed	transverse	*Graphis duplicatoinspera*
absent	striate	lateral	inspersed	muriform	(no species)
absent	striate	complete	clear	transverse	Group 17
absent	striate	complete	clear	muriform	Group 18
absent	striate	complete	inspersed	transverse	Group 19
absent	striate	complete	inspersed	muriform	Group 20

Structure and Use of the Keys

Due to the large number of species in the genus *Graphis*, the key is divided into groups according to excipulum carbonization, labium striation, ascospore septation, and hymenium inspersion. For quick access, the groups can also be identified in the tabular key (Table 1). Within each group, further divisions lead to sections by ascospore size and chemistry, and lirella morphology and other features are used to key out the individual species.

Since many species have not previously been properly typified, we have added information on type material for each species, including selection of lectotypes where necessary. Types not seen by us (about 7% of the epithets treated here) are marked as such and the literature references from which the taxonomic data were taken are then indicated; in such cases, Hale Index Cards refer to a substantial collection of type information accumulated by the late Mason Hale, which includes data on excipulum carbonization, ascospore size and septation, and chemistry, plus, in many cases, images or line drawings for a large number of names described in *Graphidaceae*. When studying the species described by Fée (1824), we realized that the persons usually given as collectors of his material, such as Humboldt and Bonpland, are in fact not the collectors of the specimens but the authors of the phorophyte plants from which the lichens were gathered. We have corrected these errors when apparent.

For space reasons, we have refrained from citing primary references, as these can be found in the cited literature and other sources, and a detailed nomenclatural checklist of *Graphidaceae* (including *Thelotremataceae*) is in preparation. Most names are referenced in the following major works: Zahlbruckner (1923), Wirth & Hale (1963, 1978), Patwardhan & Kulkarni (1976, 1977,

1979*a–c*), Patwardhan & Nagarkar (1979), Staiger (2002), Kurokawa (2003), Nakanishi *et al.* (2003*a*, *b*), Makhija & Adawadkar (2005*a*, *b*), Makhija *et al.* (2005*a*, *b*, 2006), Archer (2006, 2007*a*), Cáceres (2007), and Lücking *et al.* (2008); a few new species are described in parallel in future studies (Archer 2009; Lücking *et al.* 2009; J. Sutjaritturakan, in prep.). In a few instances, we have included invalid names as synonyms, in cases where such names have been mentioned in the literature or diseminated in online sources or are included among prominent type collections, such as TUR-Vainio. This has been done to place these names in a taxonomic context, should anyone come across them during literature or type studies.

As mentioned in the introduction, this key, although including 330 accepted species in total, is not complete, since we have not been able to check type material of several further names belonging in *Graphis* s. str., in particular at the infraspecies level. We intend to complete these studies within the next two years and plan to publish an updated version of this key in the framework of a world monograph of the genus. The main intention of the present key is to spark interest in tropical species of *Graphis* and provide the means to identify the large amount of material available in herbaria world-wide and in that way refine the concept of species and species groups. Nomenclatural novelties are indicated by an asterisk (*)

Main Key to Groups of Species of Graphis

1	Lirellae with yellow, orange, or red pigments, either as pruina on the labia, as pigment granules in between the excipular striae, as epithecial or hymenial inspersion, or in basal parts of lirellae	**Group 1**
	Lirellae lacking pigments, black, white-pruinose or white-grey due to thalline cover, sometimes faintly yellowish due to high concentration of norstictic or stictic acid but never distinctly yellow, orange, or red	2
2 (1)	Labia entire	3
	Labia, at least in thallus centre, striate in surface view, crenulate in section (sometimes only slightly so)	13
3 (2)	Excipulum apically (to peripherally) carbonized only, inner and basal parts non-carbonized, hyaline to yellow-orange or brownish	4
	Excipulum laterally to completely carbonized	6
4 (3)	Hymenium inspersed with oil droplets (see also Group 7, entry 3a)	**Graphis pertricosa (Kremp.) A. W. Archer**
	Hymenium clear	5
5 (4)	Ascospores transversely septate	**Group 2**
	Ascospores (terminally to regularly) muriform	**Group 3**
6 (3)	Excipulum laterally carbonized, basally absent or thin and non-carbonized, hyaline to yellow-orange or sometimes brownish (but lateral excipulum sometimes converging)	7
	Excipulum completely carbonized, basal carbonized part thin to thick	10
7 (6)	Hymenium clear	8
	Hymenium inspersed with oil droplets	9
8 (7)	Ascospores transversely septate	**Group 4**
	Ascospores (terminally to regularly) muriform	**Group 5**
9 (7)	Ascospores transversely septate	**Group 6**
	Ascospores (terminally to regularly) muriform	**Group 7**

10 (6) Hymenium clear 11
Hymenium inspersed with oil droplets 12

11 (10) Ascospores transversely septate . . . . . **Group 8**
Ascospores (terminally to regularly) muriform . . . . . **Group 9**

12 (10) Ascospores transversely septate . . . . . **Group 10**
Ascospores (terminally to regularly) muriform . . . . . **Group 11**

13 (2) Excipulum apically and basally carbonized but interrupted by laterally non-carbonized parts . . . . . **Group 12**
Excipulum apically to completely carbonized, not interrupted by laterally non-carbonized parts 14

14 (13) Excipulum apically (to peripherally) carbonized only, inner and basal parts non-carbonized, hyaline to yellow-orange or brownish; hymenium clear (if inspersed, cf. *Graphis nigroglauca*, see Group 13: 6a) 15
Excipulum laterally to completely carbonized; hymenium clear or rarely inspersed 16

15 (14) Ascospores transversely septate . . . . . **Group 13**
Ascospores (terminally to regularly) muriform . . . . . **Group 14**

16 (14) Excipulum laterally carbonized, basally absent or thin and non-carbonized, hyaline to yellow-orange or sometimes brownish (but lateral excipulum sometimes converging) 17
Excipulum completely carbonized, basal carbonized part thin to thick 19

17 (16) Hymenium inspersed with oil droplets; lirellae prominent, lacking thalline margin, short and sparsely branched (*striatula*-morph); ascospores small (25–35 × 5–7 µm), 7–11-septate; Neotropics (Costa Rica) and Eastern Palaeotropics (Australia) [holotype: Costa Rica, *Lücking* 17214d (F!)] . . . . . **Graphis duplicatoinspersa Lücking**

Notes. This is the only species known so far with striate labia and laterally carbonized excipula having an inspersed hymenia. However, *Graphis nigroglauca* (see Group 13: 6a), with larger ascospores (30–60 µm long) and apically or peripherally carbonized excipula, might also have an inspersed hymenium; the type has not yet been examined.

Hymenium clear 18

18 (17) Ascospores transversely septate . . . . . **Group 15**
Ascospores (terminally to regularly) muriform . . . . . **Group 16**

19 (16) Hymenium clear 20
Hymenium inspersed with oil droplets 21

20 (19) Ascospores transversely septate . . . . . **Group 17**
Ascospores (terminally to regularly) muriform . . . . . **Group 18**

21 (19) Ascospores transversely septate . . . . . **Group 19**
Ascospores (terminally to regularly) muriform . . . . . **Group 20**

Group 1: Lirellae with yellow, orange, or red pigment

1 Lirellae with yellow or orange to cinnabar-red pruina covering the labia or in between excipular striae (and then lirellae with complete thalline margin); pigment K+ salmon-yellow slowly turning purple or K+ instantly pink-purple (tetra-hydroxy-anthraquinone-1,3,6,8 and related substances) 2

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Lirellae black, lacking pigmented pruina or thalline margin; epithecium and/or hymenium or basal parts of lirellae orange or dark red; pigment K+ purple (tetra-hydroxy-anthraquinone-1,3,6,8 and related substances) or K+ green (iso-hypocrelline) 9

2 (1) Pigment yellow, K+ salmon-yellow turning slowly purple when drying; lirellae prominent to sessile, elongate and irregularly branched, with yellow pruina covering the labia to varying extent; ascospores large 3

Pigment orange-red, K+ instantly pink-purple; lirellae erumpent to sessile, short to elongate and sparsely to irregularly branched, with orange to cinnabar-red pruina covering the labia or disc or in between excipular striae; ascospores small to large 5

3 (2) Labia striate; hymenium inspersed; ascospores regularly muriform, 80–100 × 10–17 µm; Neotropics (Central America) [holotype: Costa Rica, *Sipman* 47811a (B!; isotype: INB!)] . . . . . **Graphis flavoaltamirensis Sipman & Lücking**

Labia entire; hymenium clear; ascospores transversely septate or terminally muriform only, size variable 4

4 (3) Ascospores transversely septate, 70–100 µm long; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15216 (F!)] . . . . . **Graphis firferi Lücking**

Ascospores terminally muriform, 100–170 µm long; Neotropics (Central America, Galapagos) [holotype: Costa Rica, *Moncada* 3009 (INB!)] . . . . . **Graphis flavominiata Moncada & Lücking**

5 (2) Ascospores small (20–35 × 5–8 µm); lirellae erumpent; salazinic acid; Eastern Palaeotropics [lectotype (here selected): Philippines, *Host* 15028 (TUR-Vainio 27880!)] . . . . . **Graphis ferruginea Vain.**

Ascospores medium-sized to large (70–190 × 10–25 µm); lirellae prominent to sessile; no additional substances; Neotropics and African Palaeotropics 6

6 (5) Excipulum apically carbonized; ascospores transversely septate; Neotropics [lectotype (Lücking *et al.* 2008): South America, *s.col.* (L!)] . . **Graphis lutea (Chevall.) Aptroot**

Excipulum completely carbonized; ascospores terminally or regularly muriform, size variable. 7

7 (6) Lirellae with complete thalline margin; pigment embedded in between excipular striae, not as pruina on labia, only visible when thallus cover is scraped off; ascospores terminally muriform; Neotropics [lectotype (Lücking *et al.* 2008): Brazil, *Mosén* 3145 (S 6493!)] . . . . . **Graphis miniata Redinger**

Lirellae with basal to lateral thalline margin; pigment as thick pruina on labia; ascospores terminally or regularly muriform 8

8 (7) Ascospores terminally muriform only, 70–120 × 10–15 µm; Neotropics and African Palaeotropics [holotype: Sierra Leone, *Deighton* M-4307 (FH!)] . . . . . **Graphis subchrysocarpa Lücking**

[≡ *Phaeographis ochracea* C. W. Dodge, non *Graphis ochracea* Hepp]

Ascospores regularly muriform, 120–190 × 15–25 µm; Neotropics [holotype: Brazil, *s.col.* (FI, not seen); neotype: Ecuador, Frisch 96/Eq325 (M, not seen; Staiger 2002)] . . . . . **Graphis chrysocarpa (Raddi) Spreng.**

Notes. Staiger (2002) lists three further synonyms under *Graphis chrysocarpa*: *G. ignea* Kremp. [holotype: Panama, *Wagner s.n.* (M, not seen)], *G. kermesina* Fée [holotype: Brazil, *Glaziou* 1895 (G, not seen)], *G. rubricosa* Fée [syntypes: Brazil, *Glaziou* 2159, 2173 (G, not seen)]. Without the type material, which is possibly lost, it is impossible at this point to ascertain whether these belong to *G. chrysocarpa* s.str. or any of the other, similar species recognized here (*G. subchrysocarpa*, *G. miniata*, *G. lutea*).

9 (1) Pigment orange, K+ purple (tetra-hydroxy-anthraquinone-1,3,6,8 and related substances); lirellae prominent, lacking thalline margin, with entire labia (*hossei*-morph) 10
Pigment dark red, K+ green (isohypocrelline); lirellae variable but not as above. 11

10(9) Excipulum completely carbonized; hymenium inspersed; norstictic acid; Neotropics (USA) [holotype: USA. (Florida), *Britton & Britton* 681 (NY!)] . . . . . **Graphis chromothecia R. C. Harris**
Excipulum laterally carbonized; hymenium clear; no substances; Neotropics (USA.) [holotype: USA (Florida), *Harris* 23223 (NY!)] . . . . . **Graphis inversa R. C. Harris**

11 (9) Hymenium and epithecium inspersed with red pigment; labia entire; excipulum laterally carbonized; lirellae erumpent, with apically thin thalline margins, short and sparsely branched (*negrosina*-morph); ascospores 20–45 × 6–8 μm; Palaeotropics [holotype: Philippines, *Meyen* s.n. (B, not seen; Hale Index Cards)] . . . . . **Graphis persicina G. Mey. & Flot.**
Hymenium clear; red pigment restricted to basal parts of lirellae; labia striate; excipulum laterally (to almost completely) carbonized; lirellae prominent, lacking thalline margin, elongate and irregularly branched (*striatula*-morph); ascospores 40–50 × 8–13 μm; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15297d (F!)] . . . . . **Graphis hypocrellinea Lücking & Chaves**

Group 2: Labia entire, excipulum apically carbonized, hymenium clear, ascospores transversely septate

1 Ascospores medium-sized to large (60–100 μm long), 15–23-septate; stictic acid. 2
Ascospores small to medium-sized (15–60 μm long), 3–15-septate; chemistry variable. 3

2 (1) Lirellae erumpent with lateral thalline margin, short and sparsely branched (*lineola*-morph); ascospores 75–100 μm long; Eastern Palaeotropics [holotype: India, *Patwardhan & Nagarkar* 82.262 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis valparaiensis Adaw. & Makhija**
Lirellae immersed to erumpent, with apically thick complete thalline margin, elongate and irregularly branched (*subserpentina*-morph); ascospores 65–75 μm long; Eastern Palaeotropics [lectotype (here selected, based on annotation label by Nakanish 1973): Taiwan, *Asahina* 354 (W!)] . . . . . **Graphis epiphloea Zahlbr.**
Notes. On the lectotype of *Graphis epiphloea*, Nakanishi in 1973 annotated that the species is synonymous with *G. awaensis* Vain.; both are indeed similar but the type of *G. awaensis* matches that of *G. longiramea* in having a laterally carbonized excipulum and a lateral rather than complete thalline margin, which is why we keep *G. epiphloea* separate at this point.

3 (1) Norstictic, salazinic, or stictic acid (K+ yellow or K+ yellow forming red crystals) 4
No substances (K−) 8

4 (3) Stictic acid (K+ yellow) 5
Norstictic or salazinic acid (K+ yellow forming red crystals) 6

5 (4) Ascospores medium-sized (50–60 × 10–12 μm), 9–11-septate; lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph); Eastern Palaeotropics (China) [holotype: China, *Handel-Mazzetti* 11222 (W!)] . . . . . **Graphis elegantula Zahlbr.**

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Ascospores small (20–40 × 5–8 μm), 5–9-septate; lirellae immersed, with lateral thalline margin, very long and radiately branched (*centrifuga*-morph); Eastern Palaeotropics [holotype: Philippines, *Merrill* 6724 (TUR-Vainio 27810!)] . . . . . **Graphis arecae Vain.**

6 (4) Salazinic acid; lirellae prominent, with apically thick complete thalline margin (*illinata*-morph); excipulum apically to peripherally carbonized; Eastern Palaeotropics [lectotype (Awashti & Singh 1975): India, *Thwaites* 152 (BM, not seen; Awasthi & Singh 1975; Adawadkar & Makhija 2007)] . . . . . **Graphis nematoides Leight.**

Notes. We have not been able to study the type material but this taxon might belong in *Carbacanthographis* rather than *Graphis*.

Norstictic acid; lirellae immersed to erumpent, with lateral to complete thalline margin; excipulum apically carbonized 7

7 (6) Ascospores very small (15–25 × 4–5 μm); lirellae immersed, with lateral thalline margin, elongate and irregularly branched, with disc exposed and white-pruinose (*scripta*-morph); Eastern Palaeotropics [holotype: India, *Sethy & Nagarkar* 81.578 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis alboglaucescens Adaw. & Makhija**

Ascospores small (30–40 × 4–6 μm); lirellae erumpent, with apically thin complete thalline margin, short to elongate and sparsely to irregularly branched, with disc concealed and labia non-pruinose (*negrosina*-morph); Eastern Palaeotropics [holotype: India, *Patwardhan & Badhe* 70.70 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis eburnea Adaw. & Makhija**

8 (3) Thallus ecorticate, farinose; ascospores small (25–45 × 6–10 μm). 9

Thallus corticate, smooth to uneven; ascospores variable 10

9 (8) Lirellae immersed to erumpent, with lateral thalline margin and pruinose labia, elongate and irregularly branched (*glaucescens*-morph) (see also Group 13: 16a); pantropical (also saxicolous) . . . . . **Graphis glaucescens Fée**

A. Labia entire [holotype: Paraguay, *Balansa* s.n. (G!)] . . . . . *Graphis glaucocaesia* Müll. Arg.

B. Labia entire [holotype: Philippines, *Merrill* 7051 (TUR-Vainio 27882!)] . *Graphis bulacana* Vain.

C. Labia entire [holotype: Angola, *Pechuel-Loesche* s.n. (B, not seen; Dodge 1964)] *Graphis angolensis* C. W. Dodge [≡ *Graphis caesia* Müll. Arg., nom. illeg., non Spreng.]

Lirellae immersed to erumpent, with apically thick complete thalline margin and non-pruinose labia, elongate and irregularly branched (*subserpentina*-morph); Eastern Palaeotropics [holotype: New Caledonia, *Thiébaut* s.n. (H-Nylander 7681!)] . . . . . **Graphis malacodes Nyl.**

10(8) Disc slightly exposed, white-pruinose; ascospores medium-sized (40–60 × 10–12 μm); lirellae immersed, with thick lateral thalline margin (*scripta*-morph); Eastern Paleotropics [holotype: Australia, *Bailey* 778 (G!)] . . . . . **Graphis epimelaena Müll. Arg.**

Notes. This species was considered a synonym of *Graphis glaucescens* by Archer (2006) but has larger ascospores, a corticate thallus, and a slightly exposed, pruinose disc.

Disc concealed; ascospores variable; lirellae variable 11

11(10) Labia white-pruinose; lirellae immersed to erumpent, with apically thin thalline margin, elongate and irregularly branched (*caesiella*-morph) 12

Labia non-pruinose; lirellae variable 13

12(11) Ascospores medium-sized (40–55 μm long), 9–15-septate; pantropical . . . . . **Graphis sayeri Müll. Arg.**

A. Ascospores 40–55 × 6–10 μm; lirellae immersed to erumpent [holotype: Australia, *Sayer* s.n. (G!; isotype: MEL!)] . . . . . *Graphis sayeri* Müll. Arg.

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B. Ascospores 45–55 × 5–7 µm; lirellae erumpent [lectotype (here selected): Paraguay, *Malme* 1526 *Bex* (S-6505!)] . . . . . *Graphis glaucovirens* Redinger

Ascospores small (20–40 µm long); 5–9-septate; pantropical . . . . . **Graphis xanthospora Müll. Arg.**

A. Ascospores 30–40 × 8–10 µm; lirellae immersed [holotype: Australia, *Sayer* s.n. (G!)] . . . . . *Graphis xanthospora* Müll. Arg.

B. Ascospores 25–35 × 6–8 µm; lirellae immersed to erumpent [holotype: Philippines, *Merrill* 8343 (TUR-Vainio 27885!; isotype: FH!)] . . . . . *Graphis mindanaoensis* Vain.

C. Ascospores 20–30 × 5–7 µm; lirellae immersed to erumpent [original material: Cuba, *Ekman* 53 (TUR-Vainio 27372!)] . . . . . *Graphis bayatensis* Vain. [nom. inval. (not published)]

13(11) Thallus papillose; ascospores very small (15–20 µm long), 3–5-septate; lirellae erumpent, with lateral thalline margin, short and stellately branched (*coarctata*-morph); Eastern Palaeotropics [lectotype (Awasthi & Singh 1975): India, *Watt* s.n. (BM, not seen; Awasthi & Singh 1975)] . . . . . **Graphis coarctata Stirt.**

Thallus smooth to uneven; ascospores small (20–45 µm long), 5–9-septate; lirellae erumpent, with lateral thalline margin, unbranched to radiately branched . . 14

14 (13) Lirellae very long and radiately branched (*centrifuga*-morph); excipulum apically carbonized; thallus smooth to uneven; Neotropics and Eastern Palaeotropics . . . . . **Graphis intermediella Stirt.**

A. Ascospores 20–30 × 6–8 µm [holotype: India, *s.col.* (BM, not seen; Awasthi 1991)] . . . . . *Graphis intermediella* Stirt.

B. Ascospores 20–25 × 6–7 µm [holotype: Japan, *Yasuda* 250 (TUR-Vainio 27814!)] . . . . . *Graphis batanensis* var. *rikuzensis* Vain.

Notes. Nakanishi (1966) gives the holotype of *Graphis batanensis* var. *rikuzensis* Vain. as number 27489 in hb. Vainio, but the correct number is 27814; number 27489 is *Graphis vicarians* Vain., which is a synonym of *Thecaria quassiicola* Fée. Also, Nakanishi (1966) describes the lirellae of *G. batanensis* var. *rikuzensis* as having an exposed disc but the disc on the type material is concealed and only slightly exposed in damaged lirellae.

Lirellae short and sparsely branched (*lineola*-morph); excipulum apically to peripherally carbonized; thallus conspicuously rugose; Eastern Palaeotropics [holotype: China, *Handel-Mazzetti* 2451 (W!; isotype: S-2171!)] . . . . **Graphis oligospora Zahlbr.**

Group 3: Labia entire, excipulum apically carbonized, hymenium clear, ascospores muriform

1 Ascospores medium-sized to large (45–160 × 15–35 µm); stictic acid (K+ yellow) or no substances (K−) 2

Ascospores small (15–45 × 7–18 µm); no substances (K−) 8

Notes. If ascospores small and I− and norstictic acid present, cf. *Carbacanthographis saxiseda* (Zahlbr.) Bungartz.

2(1) Stictic acid (K+ yellow) 3

No substances (K−) 5

3(2) Lirellae prominent, with thick lateral thalline margin, very short and unbranched (*dussii*-morph); Eastern Palaeotropics [holotype: Sri Lanka, *s.col.* (H-Nylander, not seen; Patwardhan & Nagarkar 1979)] . . . . . **Graphis bilabiata Nyl.**

Lirellae immersed to erumpent, with thick lateral to thick complete thalline margin, elongate and irregularly branched (*subserpentina*-morph) 4

4(3) Ascospores 1(–2) per ascus, large (70–100 × 15–30 µm) (see also Group 5: 13a); Neotropics and Eastern Palaeotropics (also saxicolous) . . . . . **Graphis streblocarpa (Bél.) Nyl.**

A. Excipulum apically carbonized; ascospores 70–95 × 20–30 µm [holotype: India, *Bélanger* s.n. (G!)] . . . . . *Opegrapha streblocarpa* Bél.
B. Excipulum apically carbonized; ascospores 80–100 × 20–25 µm [holotype: Thailand, *Hosseus* s.n. (TUR-Vainio 27215!)] . . . . . *Graphis streblocarpa* var. *pauperior* Vain.
C. Excipulum apically to peripherally carbonized; ascospores 75–100 × 20–25 µm [holotype: Philippines, *Ramos & Edaño* s.n. (TUR-Vainio 27227!)] . . . . *Graphis hiascens* var. *clausior* Vain.

Ascospores (2–)4–8 per ascus, medium-sized (45–80 × 15–25 µm) (see also Group 5: 13b); Eastern Palaeotropics . . . . . **Graphis japonica (Müll. Arg.) A. W. Archer & Lücking***

A. Excipulum apically to peripherally carbonized; ascospores 2–4 per ascus, 50–80 × 15–21 µm; thallus smooth to uneven [holotype: Indonesia, *s.col.* (W, not seen; Hale Index Cards)] . . . . . *Graphina tjibodensis* Zahlbr.
B. Excipulum apically to laterally carbonized; ascospores 4–8 per ascus, 45–50 × 15–20 µm; thallus verruculose [lectotype (here selected): China, *Chung* 600d (W!; isolectotype: FH!)]. . . . . *Graphina verruculina* Zahlbr.
C. Excipulum apically to peripherally carbonized; ascospores 2–4 per ascus, 45–75 × 15–21 µm; thallus smooth to uneven [holotype: Taiwan, *Faurie* 156 (W!)]. . *Graphina filiformis* Zahlbr.
D. Excipulum apically to peripherally carbonized; ascospores 2–4 per ascus, 60–80 × 15–25 µm; thallus smooth to uneven [holotype: Taiwan, *Faurie* 83 (W, not seen; Hale Index Cards] . . . . . *Graphina petrophila* Zahlbr.

5(2) Ascospores 6–8 per ascus; lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph) 6
Ascospores 1(–4) per ascus; lirellae variable 7

6(5) Ascospores large (70–90 × 20–25 µm); Australia [holotype: Australia, *Streimann* 56807 (CANB!)] . . . . . **Graphis coenensis A. W. Archer**
[≡ *Graphis celata* (A. W. Archer) A. W. Archer, nom. illeg., non Stirt.]

Ascospores (small to) medium-sized (25–75 × 13–20 µm); Europe [holotype: Great Britain, *s.col.* (BM, not seen; Staiger 2002)] . . . . . **Graphis britannica Staiger**
[≡ *Opegrapha pulverulenta* Sm. & Sowerby, non *Graphis pulverulenta* (Pers.) Ach.]

Notes. We have not yet studied the various synonyms of *Graphis britannica*, such as *Graphis sophistica* Nyl. ex Cromb. [non Nyl.] and *Graphis inustula* Nyl. [non Stirt.].

7(5) Disc exposed, white-pruinose; lirellae prominent, lacking thalline margin, elongate and irregularly branched (*scripta*-morph); Eastern Palaeotropics [holotype: China, *Handel-Mazzetti* 6982 (W!)] . . . . . **Graphis alpestris (Zahlbr.) Staiger**

Disc concealed, labia non-pruinose; lirellae erumpent, with apically thick complete thalline margin, elongate and irregularly branched (*subserpentina*-morph); Neotropics . . . . . **Graphis subcontorta (Müll. Arg.) Lücking & Chaves**

A. Excipulum apically to peripherally carbonized; lirellae with apically thin complete thalline margin; ascospores 80–100 × 25–35 µm [holotype: Paraguay, *Balansa* 183 (G!)]. . . . . *Graphina subcontorta* Müll. Arg.
B. Excipulum apically carbonized; lirellae with lateral thalline margin; ascospores 60–110 × 15–30 µm [original material: not designated] . . . . *Graphis pseudoserpentina* Chaves & Lücking [nom. inval. (not published)]

8(1) Thallus partly ecorticate; lirellae immersed, with apically thick complete thalline margin, elongate and irregularly branched (*subserpentina*-morph); USA, (Hawaii) [(holotype: Hawaii, *Rock* 135 (W!)] . . . . **Graphis sulphurella (Zahlbr.) Lücking***

Thallus corticate; lirellae immersed to erumpent, with lateral thalline margin, short and sparsely or stellately branched (*lineola*- or *coarctata*-morph). 9

9(8) Ascospores broad (25–45 × 13–20 µm; if ascospores partly longer than 45 µm, cf. *G. britannica*); African Palaeotropics [lectotype (here selected): South Africa, *Van der Byl* 912 (W!)] . . . . . **Graphis pergracilis (Zahlbr.) Lücking & A. W. Archer***

Notes. Graphis subnitida Nyl. *sensu* Archer (2007*b*) would key out here as potentially earlier name for *G. pergracilis*; however, the type material of *G. subnitida* (H-NYL 7449!) represents a *Fissurina*, which on

account of the slightly erumpent, fissurine lirellae and rather large (25– 35 × 12–16 µm), muriform ascospores, in combination with lack of secondary substances, is a synonym of *F. rubiginosa* (Fée) Staiger). The material reported as *G. subnitida* by Archer (2007*b*) is to be named *G. pergracilis*. The type material of *Graphina pergracilis* contains two species, one with concealed disc and apically carbonized excipulum (here selected as lectotype) and one with exposed, pruinose disc and laterally carbonized excipulum, representing *G. pyrrhocheiloides*.

Ascospores narrow (15–40 × 8–15 µm); Neotropics (also saxicolous) 10

10(9) Lirellae stellately branched (*coarctata*-morph) [holotype: Grand Cayman, *Imshaug* 24510 (MSC-0024093!)] . . . . . **Graphis astrolirellata Lücking**

Lirellae short and sparsely branched (*lineola*-morph) [lectotype (Wirth & Hale 1978): Brazil, *Vainio* 322 (TUR-Vainio 27241!)] . . . . . **Graphis dimidiata Vain.**

Group 4: Labia entire, excipulum laterally carbonized, hymenium clear, ascospores transversely septate

1 Ascospores medium-sized to large (45–135 µm long; mature ascospores usually exceeding 50 µm) 2

Ascospores small (15–45 µm long) 16

2(1) Norstictic, salazinic acid, and/or stictic acid (K+ yellow or K+ yellow forming red crystals) 3

No substances (K−) 11

3(2) Norstictic and/or salazinic acid, sometimes additionally stictic acid (K+ yellow forming red crystals) 4

Stictic acid, sometimes additionally hypostictic acid (K+ yellow) 8

4(3) Lirellae prominent, with thin complete thalline margin that often flakes off to expose black labia, short and sparsely branched (*lumbricina*-morph); ascospores 15–20 µm broad; norstictic acid (see also Group 17: 6a); Neotropics and Hawaii . . . . . **Graphis lumbricina Vain.**

Lirellae erumpent to prominent, with (thick) lateral, persistent thalline margin; ascospores 6–16 µm broad; chemistry variable [if lirellae lacking thalline margin and ascospores medium-sized (35–60 µm long, cf. *Graphis elegans*] 5

5(4) Lirellae prominent to sessile, with thick lateral thalline margin, very short and unbranched (*dussii*-morph); norstictic acid; Neotropics [holotype: Lesser Antilles (Guadelupe), *Duss* 515 (TUR-Vainio 27368!)] . . . . . **Graphis dussii Vain.**

Lirellae immersed to erumpent, with (thick) lateral thalline margin, short to elongate and sparsely to radiately branched 6

6(5) Ascospores medium-sized (45–60 µm long), 7–13-septate; lirellae short and sparsely branched (*lineola*-morph); norstictic acid; Neotropics and Eastern Palaeotropics . . . . . **Graphis erythrocardia Müll. Arg.**

A. Lirellae erumpent, with lateral thalline margin; hymenium copper-coloured (artifact?); ascospores 50–60 × 7–10 µm, 9–13-septate [holotype: Tanzania, *Holst* 3081 (G!)] . . . . . *Graphis erythrocardia* Müll. Arg.

B. Lirellae erumpent, with lateral thalline margin; hymenium colourless; ascospores 40–50 × 8–10 µm, 9–13-septate [lectotype (Archer 1999): Australia, *Knight* 341 (G!)] . . . . . *Graphis vinosa* Müll. Arg.

Ascospores medium-sized to large (45–135 µm long, mature ascospores exceeding 60 µm), (9–)11–27-septate; lirellae elongate to very long and irregularly to radiately branched (*subserpentina*-morph); salazinic acid together with norstictic or stictic acids 7

7(6) Lirellae very long and radiately branched; thallus verrucose; salazinic, stictic, hypostictic, and hypoconstictic acids; Eastern Palaeotropics [holotype: India, *Kulkarni & Prabhu* 74.3180 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis salacinilongiramea Adaw. & Makhija**

Lirellae elongate and irregularly branched; thallus smooth to uneven; salazinic and norstictic acids; Eastern Palaeotropics [holotype: India, *Awasthi* 7973 (LWU, photograph seen; Awasthi & Singh 1977; Awasthi 1991; Adawadkar & Makhija 2007)] . . . . . **Graphis longispora D. D. Awasthi & S. R. Singh**

Notes. Graphis garoana Nagarkar & Patw. would key out here, but according to the description and illustrations, this species might belong in *Carbacanthographis*.

8(3) Ascospores medium-sized to large (60–100 μm long, mature ascospores usually exceeding 70 μm) 9

Ascospores medium-sized (44–65 μm long) 10

9(8) Ascospores 4–8 μm broad; lirellae with thin lateral thalline margin, elongate and irregularly branched, disc concealed (*deserpens*-morph); Eastern Palaeotropics [holotype: India, *Sethy & Patwardhan* 86.145 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . **Graphis sitapurensis Makhija & Adaw.**

Ascospores 8–16 μm broad; lirellae with thick lateral thalline margin, elongate to very long and irregularly to radiately branched, disc often slightly exposed (*longiramea*-morph); Eastern Palaeotropics . . . . . **Graphis longiramea Müll. Arg.**

A. Lirellae radiately branched; ascospores 60–100 × 8–12 μm, 7–23-septate [lectotype (Awasthi & Singh 1975): India, *Watt* 6981 (BM, not seen; paratype: G!)] . *Graphis longiramea* Müll. Arg.

B. Lirellae irregularly branched; ascospores 50–70 × 10–12 μm, 11–17-septate [holotype: Japan, *Yasuda* 251 (TUR-Vainio 27813!)] . . . . . *Graphis awaensis* Vain.

C. Lirellae radiately branched; ascospores 50–80 × 9–14 μm, 11–17-septate [holotype: China, *Handel-Mazzetti* 9486 (W!; isotype: S 2172!)] . . . . . *Graphis multibrachiata* Zahlbr.

D. Lirellae irregularly branched; ascospores 60–85 × 12–16 μm, 13–17-septate [type: China, *Handel-Mazzetti* 12345 (W!; isotype: US!)] . . . . . *Graphis zonatula* Zahlbr.

Notes. The lectotype of *Graphis longiramea* was given as *Watt* 6981 by Awasthi & Singh (1975); the specimen in G, labelled Watt 78, according to the illustrations and description by Awasthi & Singh (1975), represents exactly the same morphotype and was also annotated as lectotype by Patwardhan & Kulkarni in 1975 and by Awasthi & Mathur in 1989. Possibly the two stem from the same original collection and there is some confusion with the collection numbers; it is unlikely but not impossible that the same species was recollected by Watt with such disparate numbers within a year.

10(8) Lirellae very narrow, with gently sloping lateral thalline margin, flexuose; excipulum laterally carbonized; Eastern Palaeotropics [holotype: New Caledonia, *Deplanche* s.n. (H-Nylander 7751!)] . . . . . **Graphis leptogramma Nyl.**

Lirellae broader, with thick and abruptly sloping lateral thalline margin, irregularly curved; excipulum laterally to almost completely carbonized; Palaeotropics . . . . . **Graphis crassilabra Müll. Arg.**

A. Ascospores 9–15-septate, 45–65 × 8–12 μm [holotype: Australia, *Hartmann* 78 (G!; isotype: MEL!)] . . . . . *Graphis crassilabra* Müll. Arg.

B. Ascospores 9–15-septate, 55–65 × 7–10 μm [holotype: Indonesia (Java), *s.col* (G!)] . . . . . *Graphis stenospora* Müll. Arg.

11(2) Thallus ecorticate; labia distinctly white-pruinose 12

Thallus corticate; labia non-pruinose or thinly white-pruinose or disc white-pruinose 13

12(11) Ascospores 45–60 μm long; lirellae erumpent, with lateral thalline margin (*glaucescens*-morph); Neotropics [lectotype (Staiger 2002): South America, *s.col.* (G!)] . . . . . **Graphis pavoniana Fée**

Ascospores 60–80 μm long; lirellae prominent, with lateral thalline margin (*farinulenta*-morph); Central America [lectotype (Lücking *et al.* 2008): Costa Rica, *Pittier* 5146 (G!)] . . . . . **Graphis farinulenta Müll. Arg.**

13(11) Lirellae prominent, with basal thalline margin, elongate and irregularly branched (*hossei*-morph) . . . . . **Graphis hossei Vain.**

A. Excipulum laterally carbonized; ascospores 2–8 per ascus, 50–110 × 8–14 µm, 11–17-septate [lectotype (based on annotation label by Nakanishi in 1973): Thailand, *Hosseus* s.n. (TUR-Vainio 27806!)] . . . . . *Graphis hossei* Vain.

B. Excipulum laterally carbonized; ascospores 8 per ascus, 40–75 × 7–11 µm, 9–15-septate [lectotype (here selected): Thailand, *Hosseus* s.n. (TUR-Vainio 27803!)] . . . . . *Graphis tenuis* Vain.

C. Excipulum laterally (to completely) carbonized; ascospores 4 per ascus, 60–110 × 10–16 µm, 11–21-septate [holotype: Philippines, *McGregor* 8652 (TUR-Vainio 27860!)] . . . . . *Graphis nematodiza* Vain.

D. Excipulum laterally carbonized; ascospores 2–4 per ascus, 70–110 × 10–15 µm, 11–19-septate [holotype: China, *Handel-Mazzetti* 12348 (W!)] . . . . . *Graphis bifera* var. *cinerea* Zahlbr.

E. Excipulum laterally (to almost completely) carbonized; ascospores 8 per ascus, 40–70 × 10–14 µm, 11–17-septate [lectotype (here selected, based on annotation label by Nakanishi 1973): China, *Handel-Mazzetti* 11429 (W!; isolectotype: S 2186!)] . . . *Graphis connectens* Zahlbr.

F. Excipulum laterally carbonized; ascospores 8 per ascus, 65–75 × 10–14 µm, 15–19-septate [holotype: Indonesia (Java) *Groenhart* 8744 (BO 7743, not seen; Groenhart 1954)] . . . . . *Graphis psidii* Groenh.

Lirellae erumpent, with (thick) lateral to complete thalline margin 14

14(13) Disc (partly) exposed, more or less white-pruinose (see also entry 32a); cosmopolitan . . . . . **Graphis scripta (L.) Ach.**

Disc concealed, labia non-pruinose 15

15(14) Lirellae stellately branched; ascospores 6–8 µm broad; Neotropics [holotype: Uruguay, *Imshaug* 42496 (MSC-0009125!)] . . . . . **Graphis uruguayensis Lücking**

Lirellae irregularly branched; ascospores 9–15 µm broad; pantropical . . . . . **Graphis elongata Zenker**

A. Excipulum laterally carbonized; lirellae with lateral thalline margin; ascospores 8 per ascus, 70–80 × 11–15 µm, 13–17-septate [lectotype: Brazil, *s.col.* (not seen; Hale Index Cards; Zenker 1829)] . . . . . *Graphis elongata* Zenker

B. Excipulum laterally (to completely) carbonized; lirellae with apically thin thalline margin; ascospores 8 per ascus, 50–75 × 9–12 µm, 11–15-septate [holotype: Australia, *Streimann* 61366 (CANB!)] . . . . . *Graphis stenospora* var. *deficiens* A. W. Archer

Notes: *Graphis elongata* Zenker was first considered an invalid name but has been validly published by Zenker (1829) and thus has precedence over *G. stenospora* var. *deficiens*.

16(1) Lichexanthone (UV+ yellow), together with norstictic acid; ascospores very small (15–20 µm long); lirellae erumpent, with basal thalline margin, elongate and irregularly branched (*hossei*-morph); Eastern Palaeotropics [holotype: Australia, *Streimann* 16826 (CANB!; isotypes: H!, US!)] . . . . **Graphis stipitata A. W. Archer**

No lichexanthone (UV−); ascospores small (15–45 µm long, mature ascospores usually exceeding 20 µm); lirellae variable 17

17(16) Norstictic, salazinic, stictic, or protocetraric acid, or traces of atranorin (K+ yellow or K+ yellow forming red crystals or P+ red) 18

Notes: If lirellae with thick white pruina containing lecanoric acid (C+ red) and thallus olive green to olive brown, cf. *Dyplolabia afzelii* (Ach.) A. Massal.; if lirellae with thick white pruina lacking lecanoric acid (C−) but thallus containing psoromic acid (P+ yellow), cf. *Carbacanthographis alloafzelii* (A. W. Archer) A. W. Archer.

No substances (K−, P−) 35

18(17) Norstictic and/or salazinic acid, sometimes additionally protocetraric or stictic acid (K+ yellow forming red crystals) 19

Stictic and/or protocetraric acid or traces of atranorin (K+ yellow or P+ red) . . 29

19(18) Salazinic acid present, sometimes additionally norstictic, stictic, and/or protocetraric acid. 20

Salazinic acid absent, norstictic acid only or rarely additionally stictic acid . . . 25

20(19) Salazinic and norstictic acid present, sometimes additionally with stictic or protocetraric acid 21
Salazinic acid only or additionally stictic acid 22

21(20) Lirellae stellately branched (*coarctata*-morph); norstictic and salazinic acids; Eastern Palaeotropics [lectotype (Awasthi & Singh 1975): India, *Watt* s.n. (BM, not seen; Awasthi & Singh 1975)] . . . . . **Graphis capillacea Stirt.**
Lirellae sparsely to irregularly branched; norstictic and salazinic acids and additionally with either protocetraric or stictic acid 23

22(20) Norstictic, salazinic, and protocetraric acids; labia white-pruinose (*caesiella*-morph); thallus white-grey; ascospores 30–35 µm long; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 17089b (CR!; isotype: F!)] . . . . . **Graphis litoralis Lücking, Sipman & Chaves**
Norstictic, salazinic, and stictic acids; labia non-pruinose (*deserpens*-morph); thallus olive-grey; ascospores 15–30 µm long; Eastern Palaeotropics [holotype: India, *Patwardhan & Nagarkar* 77.1345 (AMH, photograph seen; Nagarkar & Patwardhan 1982; Awasthi 1991; Adawadkar & Makhija 2007)]. . . . . **Graphis subasahinae Nagarkar & Patw.**

23(21) Salazinic, stictic, and constictic acids; lirellae erumpent, with lateral thalline margin (labia white-pruinose), elongate to very long and irregularly to radiately branched (*caesiella*- or *dendrogramma*-morph); Eastern Palaeotropics . . . . . **Graphis argentia Makhija & Adaw.**
A. Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched; labia white pruinose; ascospores 5–7-septate, 20–25 × 4–6 µm [holotype: India, *Patwardhan & Nagarkar* 85.2226 (AMH, photograph seen; Makhija & Adawadkar 2005)]. . . . . *Graphis argentia* Makhija & Adaw. [as *argentius*]
B. Lirellae erumpent, with lateral thalline margin, elongate to very long and irregularly to radiately branched; labia white pruinose; ascospores 5–9-septate, 15–35 × 4–6 µm [holotype: India, *Sethy & Nagarkar* 85.2158 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . *Graphis insularis* Makhija & Adaw.
Salazinic acid only; lirellae variable 24

24(23) Lirellae erumpent, with lateral thalline margin, labia white-pruinose, elongate and irregularly branched (*caesiella*-morph); Eastern Palaeotropics [lectotype (here selected, based on annotation label by Nakanishi in 1973): Philippines, *Baker* 547 (TUR-Vainio 27874!)] . . . . . **Graphis bakeri Vain.**
Notes. If ascospores small and I−, cf. *Carbacanthographis saxorum* (Egea & Torrente) Bungartz.
Lirellae prominent, with apically thick complete thalline margin (*illinata*-morph); Eastern Palaeotropics [lectotype (Awashti & Singh 1975): India, *Thwaites* 152 (BM, not seen; Awasthi & Singh 1975; Adawadkar & Makhija 2007)] . . . **Graphis nematoides Leight.**

25(19) Disc and/or labia white-pruinose 26
Disc concealed, labia non-pruinose 27

26(25) Disc exposed, white-pruinose; norstictic acid only; lirellae elongate, irregularly branched (*scripta*-morph); pantropical [holotype: Thailand, *Schmidt* s.n. (TUR-Vainio 27556!)] . . . . . **Graphis pyrrhocheiloides Zahlbr.**
[≡ *G. pyrrhocheila* Vain., nom. illeg., non Mont. & Bosch]
Disc concealed; labia white-pruinose; norstictic acid only; lirellae elongate and irregularly branched (*caesiella*-morph), pantropical (also saxicolous) . . . . . **Graphis caesiella Vain.**
A. Ascospores 5–9-septate, 20–40 × 6–8 µm [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27730!)] . . . . . *Graphis caesiella* Vain.
B. Ascospores 7–9-septate, 25–30 × 6–8 µm [holotype: Puerto Rico, *Fink* 1691 (MICH, not seen; isotype: NY!)]. . . . . *Graphis yaucoensis* Fink

C. Ascospores 7–11-septate, 25–35 × 6–8 µm [holotype: Australia, *Elix* 22579 (CANB!)] . . . . . *Graphis kakaduensis* A. W. Archer

27(25) Norstictic and stictic acids; thallus olive-grey; Eastern Palaeotropics [holotype: India, *Kushalnagar* 74.3281 (AMH, photograph seen; Patwardhan & Kulkarni 1979; Adawadkar & Makhija 2007)] . . . . . **Graphis ajarekarii Patw. & C. R. Kulk.**

Norstictic acid only; thallus white-grey to yellowish 28

28(27) Lirellae elongate to very long and irregularly to radiately branched; South-east Asia (India) . . . . . **Graphis filiformis Adaw. & Makhija**

A. Lirellae very long and radiately branched; ascospores 20–25 × 5–7 µm, 7–9-septate [holotype: India, *Mhaskar* 71.54 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . *Graphis filiformis* Adaw. & Makhija

B. Lirellae elongate and irregularly branched; ascospores 20–30 × 6–9 µm, 5–9-septate [holotype: Indonesia (Krakatau), *Van Leuwen* 271 (W!)] . . . . . *Graphis tenella* var. *elongata* Zahlbr.

Lirellae short and sparsely branched; pantropical (also saxicolous) [if excipulum completely carbonized, cf. *Graphis assimilis*] . . . . **Graphis librata C. Knight**

A. Excipulum laterally (to almost completely) carbonized; ascospores 20–30 × 5–8 µm, 5–9 -septate [lectotype (Hayward 1977): New Zealand, *Knight* 67:23 (WELT; Staiger 2002)] . . . . . *Graphis librata* C. Knight

B. Excipulum laterally carbonized; ascospores 20–25 × 5–8 µm, 5–7-septate [holotype: South Africa, *Wilms* 11 (G!)] . . . . . *Graphis diaphoroides* Müll. Arg.

C. Excipulum laterally carbonized; ascospores 25–35 × 5–8 µm [syntypes: USA (Louisiana), *Langlois* 742, 744 (PH, not seen)] . . . . . *Graphis celtidis* Müll. Arg.

D. Excipulum laterally carbonized; ascospores 25–35 × 5–8 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): USA (Palmyra Island), *Rock* 193 (W!; isolectotypes: S 4127!, US!)] . . . . . *Graphis palmyrensis* Zahlbr.

Notes. Graphis palmyrensis was considered a separate species lacking lichen substances by Lücking *et al.* (2008), but re-examination of the type demonstrated norstictic acid, as already annotated by Nakanishi in 1973; the correct name for the taxon lacking norstictic acid is *G. pinicola*.

29(18) Protocetraric acid or additionally with stictic acid 30

Stictic acid only (with accessory substances) or traces of atranorin 31

30(29) Disc exposed, white-pruinose (*scripta*-morph); protocetraric, stictic, and constictic acids; Eastern Palaeotropics [holotype: India, *Patwardhan* 85.26 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . **Graphis distincta Makhija & Adaw.**

Disc concealed, labia white-pruinose (*caesiella*-morph); protocetraric acid only; pantropical . . . . . **Graphis supracola A. W. Archer**

A. Lirellae erumpent, short to elongate and irregularly branched [holotype: Australia, *Elix* 20222 (CANB!)] . . . . . *Graphis supracola* A. W. Archer

B. Lirellae immersed (to erumpent), elongate and irregularly to radiately branched [original material: Brazil, *Höhnel* 158 (W!)] . . . *Graphis scripta* var. *candida* Zahlbr. [nom. inval. (not published)]

31(29) Lirellae with apically thick complete thalline margin, elongate and irregularly branched (*subserpentina*-morph); Neotropics [holotype: Puerto Rico, *Fink* 2167 (MICH, not seen; isotype: FH!) . . . . . **Graphis riopiedrensis (Fink) Lücking***

Lirellae with basal to lateral thalline margin or labia pruinose 32

Notes. If lirellae white-pruinose and labia with warty periphysoids, cf. *Carbacanthographis iriomotensis* (M. Nakan.) M. Nakan. & Kashiw.

32(31) Ascospores 3-septate, 12–17 µm long; atranorin (trace); lirellae erumpent, with basal thalline margin, short and sparsely branched, non-pruinose (*subregularis*-morph); African Palaeotropics [holotype: Rwanda, *Bock* s.n. (GOET, photograph seen; Bock & Hauck 2005)] . . . . . **Graphis tetralocularis C. Bock & Hauck**

Notes. This species is included here with some hesitation; we have not seen the type material, but on account of the small, 3-septate ascospores and the unusual chemistry, its placement in *Graphis* s.str. is questionable.

Ascospores 5–11-septate, 20–45 µm long; stictic acid; lirellae variable 33

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33(32) Labia non-pruinose; lirellae short and sparsely branched (*lineola*-morph); Palaeotropics . . . . . **Graphis immersella Müll. Arg**

A. Ascospores 25–40 × 6–8 µm, 7–11-septate [lectotype (Archer 1999*a*): Australia, *Shirley* 1793 (G!)] . . . . . *Graphis immersella* Müll. Arg.

B. Ascospores 35–45 × 6–8 µm, 7–9-septate [holotype: China, *Handel-Mazzetti* 5831 (W!)] . . . . . *Graphis manhaviensis* Zahlbr.

C. Ascospores 30–45 × 6–8 µm, 9–11-septate [holotype: Solomon Islands, *Hill* 10120 (BM!)] . . . . . *Graphis leptalocarpa* A. W. Archer

Labia pruinose; lirellae elongate to very long and and irregularly to radiately branched (*caesiella*-, *dendrogramma*- or *scripta*-morph) 34

34(33) Disc exposed (*scripta*-morph); Eastern Palaeotropics [holotype: India, *Jagadeesh Ram* 828 (CAL, photograph seen; Jagadeesh Ram *et al*. 2007)] . . . . . **Graphis sundarbanensis Jagadeesh Ram & G. P. Sinha**

Disc concealed (*caesiella*- or *dendrogramma*-morph); pantropical. . . . . **Graphis dendrogramma Nyl.**

A. Lirellae radiately branched; excipulum laterally (to almost completely) carbonized; ascospores 20–30 × 6–8 µm, 7–9-septate [holotype: Malaysia (Admiralty Islands), *Moseley* 1875 (H-Nylander 7165!)] . . . . . *Graphis dendrogramma* Nyl.

B. Lirellae irregularly branched; excipulum laterally carbonized; ascospores 20–40 × 5–7 µm, 5–9-septate [holotype: Sri Lanka, *Almquist* s.n. (H-Nylander 7900!)] . . . . . *Graphis ceylanica* Zahlbr. [≡ *Graphis irradians* Nyl., nom. illeg., non Fée]

C. Lirellae irregularly branched; excipulum laterally carbonized; ascospores 30–45 × 6–8 µm, 7–11-septate [holotype: Solomon Islands, 5176 (W!)] . . . . . .*Graphis bougainvillei* Zahlbr.

D. Lirellae radiately branched; excipulum laterally carbonized; ascospores 20–30 × 5–7 µm, 7–9-septate [holotype: Philippines, *McGregor* 10209 (TUR-Vainio 27812!)] . . . . . *Graphis batanensis* Vain.

E. Lirellae irregularly branched; excipulum laterally carbonized; ascospores 20–30 × 5–7 µm, 5–7-septate [holotype: Philippines, *Merrill* 8529 (TUR-Vainio 27840!)] . . . . . *Graphis subvirginea* var. *streblicola* Vain.

F. Lirellae irregularly branched; excipulum laterally carbonized; ascospores 25–35 × 5–7 µm, 5–9-septate [holotype: Philippines, *McGregor* 18421 (TUR-Vainio 27841!)] . . . . . *Graphis subvirginea* var. *rhizophorearum* Vain.

35(17) Disc at least partly exposed, usually white-pruinose (*scripta*-morph); ascospores partly longer than 45 µm (see also 35a); cosmopolitan [lectotype: Tab. XVIII and fig. 1 in Dillenius, Hist. Musc.; epitype: Sweden, *Malme* s.n. (UPS!); Staiger 2002)] . . . . . **Graphis scripta (L.) Ach.**

Notes. Graphis scripta has an extensive synonymy of about 30 specific and infraspecific epithets (see Index of Fungi) which is not listed here. We have not studied all of these in detail but suspect that this species might represent a collective taxon.

Disc concealed, labia non-pruinose or rarely thinly white-pruinose; ascospores up to 45 µm long. 36

36(35) Lirellae prominent to sessile, short to very short 37
Lirellae erumpent, short to elongate (*Graphis furcata* complex) 40

37(36) Lirellae lacking thalline margin or with basal thalline margin only; ascospores very small (15–25 µm long) 38
Lirellae with (thick) lateral thalline margin; ascospores small (30–40 µm long) . 39

38(37) Lirellae sessile, lacking thalline margin, short and unbranched (*nuda*-morph); Neotropics and Eastern Palaeotropics [holotype: South America, *s.col.* (G!)] . . . . . **Graphis nana (Fée) Spreng.**

Lirellae prominent, with basal thalline margin, elongate and partly branched (*hossei*-morph); Neotropics (Guatemala) and Eastern Palaeotropics [lectotype (here selected): Philippines, *Elmer* 14634 (TUR-Vainio 27876!)] . . . . . .**Graphis urandrae Vain.**

39(37) Lirellae prominent, with lateral thalline margin, elongate and irregularly branched (*marginata*-morph); ascospores 9–11 µm broad; Eastern Palaeotropics [holotype: Japan, *Yasuda* 182 (TUR-Vainio 27802, not seen; Nakanishi *et al.* 2003*b*)] . . . . . **Graphis prunicola Vain.**

Lirellae prominent to sessile, with thick lateral thalline margin, short and unbranched (*dussii*-morph); ascospores 4–6 µm broad; Neotropics [holotype: South America, *s.col.* (H-Acharius 658!)] . . . . . **Graphis enteroleuca (Ach.) Lücking***

40(36) Thallus partly ecorticate; lirellae thin (0·1–0·2 mm), flexuose, with gently sloping thalline margins; labia often thinly white-pruinose (*caesiella*-morph); pantropical (also foliicolous) [holotype: South America, *s.col.* (G, not seen; Staiger 2002)] . . . . . **Graphis furcata Fée**

A. Lirellae with lateral thalline margin; thallus partly ecorticate; ascospores 25–35 × 7–10 µm, 5–9-septate [holotype: South America, *s.col.* (G, not seen; Staiger 2002)] *Graphis furcata* Fée

B. Lirellae with lateral thalline margin; thallus not well-developed (foliicolous); ascospores 30–40 × 6–8 µm, 7–9-septate [holotype: Africa, *Welwitsch* 393 (TUR-Vainio 27615!)] . . . . . *Graphis foliicola* Vain.

C. Lirellae with lateral thalline margin; thallus corticate; ascospores 35–40 × 8–10 µm, 9–11-septate [holotype: China, *Handel-Mazzetti* 3075 (W, not seen; Zahlbruckner 1930; Hale Index Cards) . . . . . *Graphis setchwanensis* Zahlbr.

Thallus corticate; lirellae thicker (0·15–0·3 mm), straight or curved, with abruptly sloping thalline margin (*deserpens*- or *subserpentina*-morph); labia always non-pruinose 41

41(40) Lirellae elongate to very long and irregularly to radiately branched, with thick lateral thalline margin (*subserpentina*-morph); Eastern Palaeotropics . . . . . **Graphis albissima Müll. Arg.**

A. Ascospores 30–40 × 7–8 µm, 9–11-septate [holotype: Australia, *Knight* 147 (G!)] . . . . . *Graphis albissima* Müll. Arg.

B. Ascospores 35–45 × 5–7 µm, 9–13-septate [holotype: India, *Sethy & Patwardhan* 87.348 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . *Graphis leptocarpoides* Makhija & Adaw.

Lirellae short to elongate and sparsely to irregularly branched (*lineola*- or *deserpens*-morph); pantropical (also foliicolous) . . . . . **Graphis pinicola Zahlbr.**

A. Lirellae with lateral thalline margin; ascospores 25–35 × 10–12 µm, 7-septate [holotype: China, *Handel-Mazzetti* 2829 (W!; isotype: US!)] . . . . . *Graphis pinicola* Zahlbr.

B. Lirellae with lateral thalline margin; ascospores 20–30 × 5–8 µm, 5–7-septate [holotype: China, *Handel-Mazzetti* 11462 (W, not seen; Zahlbruckner 1930; Hale Index Cards)] . . . . . *Graphis castanopsidis* Zahlbr.

C. Lirellae with apically thin complete thalline margin; ascospores 30–45 × 5–8 µm, 7–11-septate [holotype: India, *Singh* 71.429 (LWU; not seen; Awasthi & Singh 1972)] . . . . . *Graphis foliicola* var. *major* Awasthi & Singh

D. Lirellae with apically thin complete thalline margin; ascospores 25–30 × 7–9 µm, 9-septate [holotype: Sierra Leone, *Deighton* M-4345 (FH!)] . . . . . *Graphis guineensis* C. W. Dodge

Notes. This taxon was named *Graphis palmyrensis* by Lücking *et al.* (2008), but re-examination of the type demonstrated norstictic acid, as already annotated by Nakanishi in 1973; the correct name for the taxon lacking norstictic acid is thus *G. pinicola*.

Group 5: Labia entire, excipulum laterally carbonized, hymenium clear, ascospores muriform

1 Norstictic, salazinic, or stictic acid (K+ yellow or K+ yellow forming red crystals) 2

Notes. If lirellae with thick white pruina containing lecanoric acid (C+ red) and thallus olive-green to olive-brown, cf. *Dyplolabia oryzoides* (Leight.) Kalb & Staiger.

No substances or in two species with unknown substances (K−) 14

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2 (1) Norstictic acid, sometimes additionally with salazinic acid (K+ yellow forming red crystals) . . . 3
Stictic acid (K+ yellow) . . . 12

Notes. If salazinic acid major and ascospores I−, 12–17 × 5–7 µm, cf. *Carbacanthographis marcescens* (Fée) Staiger & Kalb.

3 (2) Ascospores 1(–2) per ascus, medium-sized to large [(40–)50–150 µm long] . . . 4
Ascospores (2–)4–8 per ascus, small (20–50 µm long) . . . 8

4 (3) Ascospores medium-sized [(40–)50–70 µm long]; lirellae immersed to erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph); Eastern Palaeotropics [holotype: Philippines, *Copeland* 196 (TUR-Vainio 27257!)] . . . **Graphis copelandii Vain.**
Ascospores large (70–150 µm long); lirellae erumpent or prominent, with (thick) lateral thalline margin . . . 5

5 (4) Lirellae erumpent, with (thick) lateral thalline margin, elongate and irregularly branched (*subserpentina*-morph); Palaeotropics. . **Graphis subserpentina Nyl.**
A. Ascospores 80–130 × 20–35 µm [holotype: Sri Lanka, *Hooker* 8012 (G!; isotype: US!)] . . . *Graphis subserpentina* Nyl.
B. Ascospores 70–150 × 20–25 µm [holotype: Malaysia (Malacca), *Maingay* s.n. (H-NYL 8018!)] . . . *Graphis adtenuans* Nyl.
C. Ascospores 70–120 × 15–25 µm [holotype: Singapore, *s.col.* (W, not seen; Hale Index Cards)] . . . *Phaeographina alutacea* Zahlbr.
Lirellae erumpent to prominent, with thick lateral to complete thalline margin, short and unbranched . . . 6

6 (5) Lirellae with apically thick complete thalline margin (*illinata*-morph); ascospores up to 170 × 45 µm; Eastern Palaeotropics (Thailand) [holotype: Thailand, *Moon & Nakanishi* 2295 (TNS, photograph seen; isotype: RAMK!) . . . **Graphis rongklaensis Sutjaritturakan**
[≡ *Graphina vestita* M. Nakan., Kashiw. & K. H. Moon, non *Graphis vestita* Fr. nec *Graphis vestita* Fée]
Lirellae with lateral thalline margin (*dussii*-morph); ascospores up to 120 × 35 µm . . . 7

7 (6) Norstictic and salazinic acid; Eastern Palaeotropical [holotype: India, *Patwardhan & Nagarkar* 77.1417 (AMH, photograph seen; Patwardhan & Nagarkar 1979)]. . . . **Graphis awasthii (Patw. & Nagarkar) Lücking★**
Norstictic acid only; pantropical [holotype: South America, *s.col.* (G!)]. . . . **Graphis hiascens (Fée) Nyl.**

Notes. This taxon requires further study; except for the type, all collections available have very short lirellae of the *dussii*-morph, whereas in the type they are longer and less prominent; potentially this represents a collective species.

8 (3) Lirellae prominent, with basal thalline margin (*hossei*-morph); Palaeotropics . . . **Graphis analoga Nyl.**
A. Lirellae short to elongate; excipulum laterally (to almost completely) carbonized; ascospores 6–8 per ascus, 20–30 × 8–12 µm [holotype: Tahiti, *Viellard & Planchet* G13:8 (H-Nylander 7432!)] . . . *Graphis analoga* Nyl.
B. Lirellae short; excipulum laterally (to almost completely) carbonized; ascospores 8 per ascus, 25–35 × 8–12 µm [holotype: Philippines, *Merrill* 9056 (TUR-Vainio 27251!)] . . . *Graphis analoga* var. *nana* Vain.
C. Lirellae elongate; excipulum laterally (to almost completely) carbonized; ascospores 8 per ascus, 30–40 × 10–14 µm [holotype: Thailand, *Schmidt* s.n. (TUR-Vainio 27198!)] . . . *Graphis simplex* Vain.
Lirellae erumpent to prominent, with lateral thalline margin . . . 9

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9 (8) Lirellae prominent, with apically thick complete lateral thalline margin, very short and unbranched (*cleistomma*-morph); ascospores (small to) medium-sized (40–50 × 13–16 µm); Eastern Palaeotropics [holotype: Papua New Guinea, *Aptroot* 38161 (B!)] . . . . . **Graphis nadurina Aptroot⋆**

Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph) 10

10 (9) Ascospores small (20–35 × 8–14 µm); pantropical . . . . . **Graphis renschiana (Müll. Arg.) Stizenb.**

A. Lirellae with lateral thalline margin; excipulum laterally carbonized; ascospores 8 per ascus, 25–35 × 10–14 µm [holotype: unknown locality, *s.col.* (UPS!)] *Opegrapha gracilis* Fr. [non Fée]

B. Lirellae with lateral thalline margin; excipulum laterally carbonized; ascospores 8 per ascus, 25–35 × 9–12 µm [holotype: Madagascar, *Rensch* 969 (G!)] . *Graphina renschiana* Müll. Arg.

C. Lirellae with thick lateral thalline margin; excipulum laterally carbonized; ascospores 4–8 per ascus, 20–30 × 8–12 µm [holotype: Philippines, *Rosenbluth & Tamesis* 13753 (TUR-Vainio 27185!)] . . . . . *Graphis antillarum* var. *manilensis* Vain.

D. Lirellae with lateral thalline margin; excipulum laterally (to almost completely) carbonized; ascospores 4–8 per ascus, 25–35 × 9–13 µm [holotype: China, *Handel-Mazzetti* 11459 (W!; isotype: S 3963!)] . . . . . *Graphina symplocorum* Zahlbr.

Notes. There is some confusion as to the application of the name *Graphis gracilis*: Zahlbruckner (1923) cited *G. gracilis* (Fr.) Leight. as the combination; however, Leighton (1869) did not actually recombine *Opegrapha gracilis* Fr. into *Graphis*, as assumed by Zahlbruckner (1923) and Lücking *et al.* (2008), but instead based his *G. gracilis* (Eschw.) (sic!) on *Ustalia gracilis* Eschw. and cited a Fée illustration that refers to a taxon now included in *Arthoniales*. Thus, the earliest available epithet, *gracilis* (from *Opegrapha gracilis* Fr.), cannot be used for the taxon delimited here, since the combination *Graphis gracilis* is blocked by Leighton's original combination, and hence the next available epithet *renschiana* has to be taken up.

Ascospores (small to) medium-sized (35–50 × 10–25 µm) 11

11(10) Ascospores 17–25 µm broad; Eastern Palaeotropics (Australia) [holotype: Australia, *Streimann* 56574 (CANB!)] . . . . **Graphis borealis (A. W. Archer) A. W. Archer**

Ascospores 10–16 µm broad; Palaeotropics [holotype: Philippines, *Baker* 1253 (TUR-Vainio 27260!)] . . . . . **Graphis norstictica A. W. Archer & Lücking⋆**

12(2) Ascospores small (20–35 × 8–12 µm); lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph); Eastern Palaeotropics [holotype: Philippines, *McGregor* 8544 (TUR-Vainio 27234!)] . . . . **Graphis deserpens Vain.**

Ascospores medium-sized to large (45–100 × 15–25 µm); lirellae erumpent, with thick lateral to complete thalline margin (*subserpentina*-morph) 13

Notes. If lirellae prominent and with distinct white pruina, cf. *Carbacanthographis cleitops* (Fée) Lücking⋆ and *C. triphoroides* (M. Wirth & Hale) Lücking⋆.

13(12) Ascospores single (see also Group 3: 4a); Neotropics and Eastern Palaeotropics . . . . . **Graphis streblocarpa (Bél.) Nyl.**

A. Excipulum laterally carbonized; ascospores 60–100 × 15–25 µm [lectotype (Archer 2006): Sri Lanka, *Thwaites* CL 75 (BM!)] . . . . . *Graphis fissofurcata* Leight.

Notes. According to the description and illustrations in the protologue, *Graphina indica* D. D. Awasthi & S. R. Singh (Awasthi & Singh 1977) would key out here. The described K-reaction suggests stictic acid, but we have not studied the type and TLC is necessary to establish the exact compounds present. If lirellae prominent and with distinct white pruina, cf. *Carbacanthographis cleitops* (Fée) Lücking⋆.

Ascospores 2–8 per ascus (see also Group 3: 4); Eastern Palaeotropics . . . . . **Graphis japonica (Müll. Arg.) A. W. Archer & Lücking⋆**

A. Lirellae with thick complete thalline margin; ascospores 2–4/ascus, 50–70 × 18–25 µm [holotype: Japan, *Miyoshi* 23 (G!)]. . . . . *Graphina japonica* Müll. Arg.

B. Lirellae with thick lateral thalline margin; ascospores 2/ascus, 60–80 × 20–25 µm [lectotype (here selected): Taiwan, *Asahina* 338 (W!)] . . . . . *Graphina japonica* var. *major* Zahlbr.

Notes. If lirellae prominent and with distinct white pruina, cf. *Carbacanthographis triphoroides* (M. Wirth & Hale) Lücking⋆.

14 (1) Ascospores medium-sized to large (50–140 × 15–40 µm) 15
Ascospores small (20–50 × 7–18 µm) 22

Notes. *Graphina pauciloculata* Coppins & P. James (Coppins & James 1978) would key out here; we have not seen the type material but judging from the excellent description and photographs, due to its aggregate-stromatic lirellae and very small ascospores this species does not appear to belong in *Graphis* s.str.; its generic home is unclear.

15(14) Ascospores large (100–140 × 30–40 µm); thallus verrucose; lirellae prominent, with apically thin complete thalline margin (*rhizocola*-morph); Eastern Palaeotropics [holotype: Australia, *Hafellner* 16977 (CANB!)] . . . . . **Graphis atrocelata (A. W. Archer) A. W. Archer**
Ascospores medium-sized to large (50–100 × 15–30 µm); thallus smooth to uneven; lirellae variable 16

16(15) Lirellae very short, almost round to ellipsoid, prominent, with apically thick complete thalline cover (*globosa*-morph); Neotropics [holotype: Colombia, *Lindig* 2652 (H- Nylander 7588!)] . . . . . **Graphis triphora Nyl.**
Lirellae distinctly elongate, erumpent to prominent, with lateral to apically thick complete thalline margin 17

17(16) Ascospores single 18
Ascospores 2–8 per ascus 20

18(17) Ascospores 50–60 × 15–20 µm; lirellae short and stellately branched (*coarctata*-morph); Eastern Paleotropics [holotype: Japan, *Nakanishi* 1902 (HIRO, not seen; Nakanishi 1966)] . . . . . **Graphis kousyuensis (Horik. & M. Nakan.) Lücking***

Notes. This taxon was placed as a synonym of *Graphis alpestris* by Kurokawa (2003) but according to the description given by Nakanishi (1966, 1967) differs in the laterally carbonized excipulum and the stellate lirellae.

Ascospores 55–100 × 15–30 µm; lirellae elongate and irregularly branched . . . 19

19(18) Lirellae prominent, with basal thalline margin (*hossei*-morph); Eastern Palaeotropics . . . . . **Graphis daintriensis (A. W. Archer) A. W. Archer**

A. Excipulum laterally (to completely) carbonized; ascospores 55–95 × 15–30 µm [holotype: Australia, *Streimann* 45823 (CANB!)] . . . . . *Graphina daintriensis* A. W. Archer

B. Excipulum laterally carbonized; ascospore size unknown [original material: not designated] . . . . . *Graphina chartarna* F. Wilson [nom. inval. (not published)]

Lirellae erumpent, with lateral to apically thick complete thalline margin (*subserpentina*-morph); pantropical [holotype: Tanzania, *Holst* 696 (G!)] . . . . . **Graphis subhiascens (Müll. Arg.) Lücking**

20(17) Lirellae prominent, with basal thalline margin, elongate and irregularly branched (*hossei*-morph); Eastern Palaeotropics [holotype: Papua New Guinea, *Aptroot* 37428 (B!)] . . . . . **Graphis myolensis Aptroot***
Lirellae erumpent, with lateral to apically thick complete thalline margin (*subserpentina*-morph) 21

21(20) Ascospores 1–2 per ascus, 70–90 × 20–30 µm; lirellae with lateral thalline margin; Neotropics [holotype: USA (Florida), *Harris* 23900 (NY!)] . . . . . **Graphis xylophaga (R. C. Harris) Lendemer** [non (R. C. Harris) Lücking]

Notes. This species was simultaneously recombined in *Graphis* by Lendemer & Knudsen (2008) and Lücking *et al.* (2008), and the first publication predates the second one.

Ascospores 2–4/ascus, 50–70 × 15–22 µm; lirellae with almost complete thalline margin; Neotropics and Eastern Palaeotropics [holotype: Brazil, *Glaziou* 3303 (G!)] . . . . . **Graphis lapidicola Fée**

Notes. If lirellae with exposed, brown-pruinose disc and apically anastomosing paraphyses, cf. *Glyphis atrofusca* (Müll. Arg.) Lücking*.

22(14) Lirellae erumpent; disc exposed (*scripta*-morph) 23
Lirellae erumpent to prominent; disc concealed 24

23(22) Ascospores 20–30 µm long; pruina on disc thin; Eastern Palaeotropics [holotype: Australia, *Gwyther* s.n. (BRI!)] . . . . **Graphis tenuirima (Shirley) A. W. Archer**
Ascospores 15–20 µm long; pruina on disc thick; Eastern North America [holotype: USA., *Calkins* s.n. (H-Nylander!)] . . . . . **Graphis sophisticascens Nyl.**
Notes. We have kept the above two taxa separate since they differ slightly in ascospore size and also in distribution, but further data are needed to test whether this separation can be maintained. A collection from French Guiana (*LeGallo* 4532, FH!) is somewhat intermediate and would support merging the two taxa.

24(22) Lirellae with apically thin complete thalline margin, stellately branched (*evirescens*-morph); thallus green; unknown substances; Neotropics [holotype: Brazil, *Malme* 3527 (S 5540!)] . . . . . **Graphis evirescens (Redinger) Lücking***
Lirellae with basal to lateral thalline margin, sparsely branched (*hossei*- or *lineola*-morph); thallus white-grey; substances absent 25

25(24) Lirellae with basal thalline margin (*hossei*-morph); ascospores 30–40 µm long; Eastern Paleotropics [holotype: Thailand, *Schmidt* s.n. (TUR-Vainio 27256!)] . . . . . **Graphis consimilis Vain.**
Lirellae with lateral thalline margin (*lineola*-morph); ascospores 30–50 µm long; pantropical [lectotype (here selected): Philippines, *Copeland* 1382 (TUR-Vainio 27261!)] . . . . . **Graphis nanodes Vain.**

Group 6: Labia entire, excipulum laterally carbonized, hymenium inspersed, ascospores transversely septate

1 Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals). 2
No substances (K−) 9

2 (1) Stictic acid (K+ yellow) 3
Norstictic acid (K+ yellow forming red crystals) 4

3 (2) Ascospores small (20–40 × 6–8 µm); lirellae erumpent, with lateral thalline margin, short and sparsely branched (*lineola*-morph); pantropical [lectotype (Wirth & Hale 1978): South America, *s.col.* (G!)] . . . . . **Graphis leptocarpa Fée**
Ascospores medium-sized (40–60 × 10–14 µm); lirellae erumpent, with lateral to complete thalline margin, short to elongate and sparsely to irregularly branched (*subserpentina*-morph); Eastern Palaeotropics [holotype: Taiwan, *Faurie* 30 (W!)]. . . . . **Graphis kelungana Zahlbr.**

4 (2) Ascospores (small to) medium-sized (40–70 µm long); lirellae erumpent, with lateral thalline margin, elongate and irregularly branched; disc exposed, white-pruinose (*scripta*-morph); Australia [holotype: Australia, *Streimann* 48626 (CANB!)] . . . . . **Graphis streimannii A. W. Archer**
Ascospores small to very small (15–45 × 5–9 µm); lirellae variable 5

5 (4) Disc exposed; lirellae erumpent, with lateral thalline margin, short to elongate and sparsely to irregularly branched (*handelii*- or *scripta*-morph) 6
Notes. This is a difficult complex including four described names whose types differ chiefly in the pruinosity of the disc and (slightly) in ascospore size. We have separated two taxa, one with pruinose disc and one with non-pruinose disc. The slight differences in ascospore size between the type material of *Graphis crebra* and *Graphis apertella* are not considered taxonomically important, since both fall within the typical range of small-sized ascospores.
Disc concealed; lirellae variable 7

6 (5) Disc white-pruinose (*scripta*-morph); pantropical . . . . . **Graphis crebra Vain.**
A. Ascospores 5–9-septate, 20–30 × 5–8 µm [holotype: Guadeloupe, *Duss* 541 (TUR-Vainio 27617!)] . . . . . *Graphis crebra* Vain.
B. Ascospores 7–11-septate, 25–45 × 6–9 µm [holotype: Australia, *Streimann* 9367 (CANB!)] . . . . . *Graphis apertella* A. W. Archer

Disc non-pruinose (*handelii*-morph); pantropical . . . **Graphis handelii Zahlbr.**
A. Excipulum laterally (to almost completely) carbonized; ascospores 7–9-septate, 30–45 × 6–9 µm [lectotype (Lücking *et al.* 2008): Paraguay, *Malme* 1900 (S- 6496!)] . . . . . *Graphis lineola* var. *chondroplaca* Redinger
B. Excipulum laterally carbonized; ascospores 7–11-septate, 25–40 × 7–10 µm [holotype: India, *Watt* s.n. (BM, not seen; Staiger 2002)] . . . . . *Schistostoma dehiscens* Stirt. [non *Graphis dehiscens* Vain.]
C. Excipulum laterally carbonized, ascospores 5–11-septate, 20–40 × 6–9 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): China, *Handel-Mazzetti* 12788 (W!; isolectotype: S 2181!)] . . . . . *Graphis handelii* Zahlbr.

Notes. Initially we took up the epithet *chondroplaca* for this taxon (Lücking *et al*. 2008), but revision of the lectotype material of *G. handelii*, first considered a synonym of *G. lineola*, showed more or less exposed discs and norstictic acid and hence *handelii* becomes the valid epithet for the species.

7 (5) Labia white-pruinose; lirellae immersed, with lateral thalline margin (*caesiella*-morph); Neotropics [holotype: Guadeloupe, *Duss* 1189 (TUR-Vainio 27732!)] . . . . . **Graphis plumierae Vain.**

Labia non-pruinose; lirellae variable 8

8 (7) Lirellae short and broad (up to 0·6 mm broad), immersed, with apically thick complete thalline margin (*subserpentina*-morph); ascospores very small (15–20 µm long); Oceania [holotype: Vanuatu, *Kashiwadani* 43246 (TNS, not seen; Nakanishi *et al.* 2002)] . . . . . **Graphis brevicarpa M. Nakan., Kashiw. & K. H. Moon**

Lirellae elongate and slender (up to 0·25 mm broad), erumpent, with basal to (thick) lateral thalline margin (*lineola*-morph); ascospores small (25–45 µm long); pantropical . . . . . **Graphis cincta (Pers.) Aptroot***
A. Lirellae with lateral thalline margin; ascospores 7–9-septate, 25–35 × 7–8 µm [holotype: Dominican Republic, *s.col.* (L!; isotypes: L!)] . . . . . *Opegrapha cincta* Pers.
B. Lirellae with basal to lateral thalline margin; ascospores 7–9-septate, 35–45 × 7–9 µm [holotype: Dominica, *Raunkiaer* 490 (TUR-Vainio 27701!; isotype: FH!)] . . . *Graphis tenellula* Vain.
C. Lirellae with lateral thalline margin; ascospores 7–11-septate, 25–45 × 7–9 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): Philippines, *Merrill* 6716 (TUR-Vainio 27811!)] . . . . . *Graphis guimarana* Vain.
D. Lirellae with basal thalline margin; ascospores 7–9-septate, 25–35 × 6–8 µm [holotype: Philippines, *Merrill* 6344 (TUR-Vainio 27722!)] . . . . . *Graphis tenella* var. *jatrophae* Vain.
E. Lirellae erumpent, with lateral thalline margin; ascospores 30–40 × 6–8 µm, 5–9-septate [holotype: Taiwan, *Faurie* 291 (W!)] . . . . . *Graphis latibasa* Zahlbr.
F. Lirellae with lateral thalline margin; ascospores 5–9-septate, 25–30 × 5–7 µm [lectoype (here selected): Paraguay, *Malme* 1663Bc (S 6500!)] . . . . . *Graphis inspersa* Redinger
G. Lirellae with thick lateral thalline margin; ascospores 7–9-septate, 35–45 × 6–8 µm [original material: Philippines, *Merrill* 6736 (TUR-Vainio 27706!)] . . . . . *Graphis tenellula* var. *eutypodes* Vain. [nom. inval. (not published)]

Notes. *Opegrapha cincta* was found to be the oldest epithet available for this taxon usually known as *G. tenellula*.

9 (1) Ascospores (small to) medium-sized (40–80 × 8–12 µm), 11–17-septate 10

Ascospores small (20–40 × 6–9 µm), 5–11-septate 12

10 (9) Lirellae erumpent, with basal thalline margin (labia black), short and sparsely branched (*subregularis*-morph); Australia [holotype: Australia, *Elix* 17392 (CANB!)] . . . . . **Graphis subregularis A. W. Archer**

Lirellae distinctly elongate, partly to radiately branched, with (thick) lateral thalline margin 11

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11(10) Lirellae with lateral thalline margin, very long and radiately branched (*centrifuga*-morph); ascospores 50–80 µm long; Neotropics [holotype: Jamaica, *Imshaug* 14632 (MSC-0029034!)] . . . . . **Graphis inspersoradians Lücking**

Lirellae with thick lateral thalline margin, short and sparsely branched (*subserpentina*-morph); ascospores 40–55 µm long; Eastern Palaeotropics [holotype: Thailand, *Hosseus* s.n. (TUR-Vainio 27214!)] . . . . . **Graphis intermedians Vain.**

12(9) Disc exposed, white-pruinose; lirellae erumpent, with lateral thalline margin (*scripta*-morph); pantropical [holotype: Indonesia (Java), *s.col.* (not seen)] . . . . . **Graphis submarginata Lücking**

[≡ *Graphis marginata* G. Mey. & Flot., nom. illeg., non Raddi]

Disc concealed, labia non-pruinose; lirellae erumpent, with lateral thalline margin (*lineola*-morph); pantropical . . . . . **Graphis lineola Ach.**

A. Lirellae with lateral thalline margin; ascospores 7–9-septate, 20–40 × 6–8 µm [holotype: Lesser Antilles, *Swartz* s.n. (H-Acharius 584!)] . . . . . *Graphis lineola* Ach.

B. Lirellae with lateral thalline margin; ascospores 7–9-septate, 25–35 × 5–8 µm [holotype: Sierra Leone, *Deighton* 4307E (FH!)] . . . . . *Graphis deightonii* C. W. Dodge

Group 7: Labia entire, excipulum laterally carbonized, hymenium inspersed, ascospores muriform

1 Norstictic, stictic, or protocetraric acid (K+ yellow or K+ yellow forming red crystals or P+ red) 2

No substances (K−, P−) 6

2(1) Norstictic acid (K+ yellow forming red crystals) 3

Stictic or protocetraric acid (K+ yellow or P+ red) 4

3(2) Ascospores small (25–40 × 8–14 µm), 8 per ascus; lirellae erumpent, with apically thin thalline margin, short and sparsely branched (*negrosina*-morph); thallus verrucose; Eastern Palaeotropics including Australia [holotype: Malaysia (Borneo), *Beccari* 165 (M!; isotype: W!)] . . . . **Graphis pertricosa (Kremp.) A. W. Archer**

Ascospores large (50–110 × 15–30 µm), 1–2 per ascus; lirellae immersed to erumpent, with thick lateral to complete thalline margin, elongate and irregularly branched (*subserpentina*-morph); pantropical . . . . . **Graphis insulana (Müll. Arg.) Lücking**

A. Lirellae erumpent, with thick lateral thalline margin; ascospores 1–2/ascus, 60–90 × 20–30 µm [holotype: Fiji, *s.col.* (G!)] . . . . . *Graphina insulana* Müll. Arg.

B. Lirellae immersed, with lateral thalline margin; ascospores single, 80–100 × 18–28 µm [holotype: Australia, *Sayer* s.n. (G!)] . . . . . *Graphina subtartarea* Müll. Arg.

C. Lirellae erumpent, with thick lateral thalline margin; ascospores single, 50–100 × 20–30 µm [lectotype (Lücking *et al.* 2008): São Tomé & Principé, *Fr. Quintas* s.n. (H-Nylander 7414!)] . . . . . *Graphina rudescens* Nyl.

D. Lirellae erumpent, with lateral thalline margin; ascospores single, 80–100 × 20–30 µm [holotype: Costa Rica, *Pittier* 5238 (G!)] . . . . . *Graphina robusta* Müll. Arg.

E. Lirellae erumpent, with thick lateral thalline margin; ascospores 1–2/ascus, 55–110 × 15–30 µm [lectotype (Lücking *et al.* 2008): Philippines, *McGregor* 18445 (TUR-Vainio 27230!)] . . . . . *Graphis orientalis* Vain.

F. Lirellae immersed, with thick lateral thalline margin; ascospores single, 50–110 × 15–25 µm [holotype: Mariana Islands (Guam), *McGregor* 607 (TUR-Vainio 27242!)] . . . . . *Graphis macgregorii* Vain.

G. Lirellae erumpent, with thick lateral thalline margin; ascospores single, 70–100 × 20–30 µm [holotype: Sierra Leone, *MacDonald* s.n. (FH!)] . . . . *Graphina sierraleonensis* C. W. Dodge

H. Lirellae erumpent, with thick lateral thalline margin; ascospores single, 80–100 × 20–30 µm [holotype: India, *Patwardhan & Nagarkar* 74.3053 (AMH!)] . . . . . *Graphina nylanderi* Patw. & C. R. Kulk.

4(2) Protocetraric acid (P+ red); lirellae prominent, with thick lateral thalline margin, very short and unbranched (*dussii*-morph); ascospores large (90–105 × 20–30 µm); Eastern Palaeotropics [holotype: Philippines, *Elmer* 14924 (TUR-Vainio 27262!; isotype: FH!)] . . . . . **Graphis sorsogona Vain.**

Stictic acid (K+ yellow); lirellae variable; ascospores small to large (35–150 × 11–25 µm) 5

5(4) Ascospores 8 per ascus, small to medium-sized (35–50 × 11–13 µm); lirellae erumpent, with lateral thalline margin, short and sparsely branched (*lineola*-morph); thallus yellow-green; Australia [holotype: Australia, *Fawcett* s.n. (M!)] . . . . . **Graphis polyclades Kremp.**

Ascospores 1–2 per ascus, medium-sized to large (50–130 × 15–25 µm); lirellae erumpent, with thick complete thalline margin, short to elongate and sparsely to irregularly branched (*subserpentina*-morph); thallus white-grey with yellow tinge; Palaeotropics [holotype: Philippines, *McGregor* 8605 (TUR-Vainio 27239!)] . . . . . **Graphis diplocheila Vain.**

6(1) Ascospores small to medium-sized (35–50 × 8–15 µm), lirellae erumpent, with lateral thalline margin, short to elongate and sparsely to irregularly branched (*lineola*- or *deserpens*-morphs); Palaeotropics (also saxicolous) . . . . . **Graphis subvelata Stirt.**

A. Lirellae erumpent, with lateral thalline margin; ascospores 35–45 × 8–12 µm [lectotype (Rogers 1982): Australia, *Bailey* s.n. (BM!)] . . . . . *Graphis subvelata* Stirt.

B. Lirellae erumpent, with thick lateral thalline margin; ascospores 40–50 × 10–15 µm [holotype: Angola, *Welwitsch* 392 (TUR-Vainio 27197!)] . . . . . *Graphis ambrizensis* Vain.

Ascospores very large (75–250 × 25–30 µm); lirellae prominent, with thin complete thalline margin, short and sparsely branched (*negrosina*-morph); Neotropics [holotype: Brasil, *Cáceres & Lücking* 01-0514 (F!; isotype: B!)] . . . . . **Graphis pilarensis Cáceres & Lücking**

Group 8: Labia entire, excipulum completely carbonized, hymenium clear, ascospores transversely septate

1 Ascospores medium-sized to large (45–120 µm long, mature ascospores exceeding 50 µm) 2

Ascospores small (15–50 µm long, mature ascospores rarely exceeding 45 µm) . 29

2 (1) Lichexanthone (UV+ yellow); lirellae prominent, with basal thalline margin or thalline margin lacking (*hossei*-morph); ascospores 8 per ascus, 7–15-septate, 45–60 ×10–14 µm; Neotropics [holotype: Brazil, *Spruce* 331 (BM, not seen; Staiger 2002)] . . . . . **Graphis sauroidea Leight.**

Notes. If additionally protocetraric acid and ascospores I− and up to 100 µm long, cf. *Carbacanthographis candidata* (Nyl.) Staiger & Kalb; if additionally protocetraric acid and ascospores I− and 20–25 × 6–8 µm, cf. *Carbacanthographis chionophora* (Redinger) Staiger & Kalb.

Lichexanthone absent (UV−); lirellae and ascospores variable 3

3 (2) Norstictic, stictic, and/or salazinic acids (K+ yellow or K+ yellow forming red crystals) 4

No substances (K−) 12

4 (3) Stictic acid, norstictic and salazinic acids absent (K+ yellow) 5

Norstictic and/or salazinic acid present, sometimes additionally stictic acid (K+ yellow forming red crystals) 7

Notes. If protocetraric acid and ascospores I−, cf. *Carbacanthographis candidata* (Nyl.) Staiger & Kalb.

5 (4) Lirellae prominent, with thick lateral thalline margin, elongate and irregularly branched (*marginata*-morph); pantropical . . . . . **Graphis rustica Kremp.**

A. Ascospores 8 per ascus, 11–17-septate, 65–85 × 8–11 µm [lectotype (Archer 2006 based on annotation label by Nakanishi in 1973): Singapore, *Beccari* 258 (M!)] . *Graphis rustica* Kremp.

B. Ascospores 6–8 per ascus, 9–17-septate, 60–100 × 10–14 µm [lectotype (Wirth & Hale 1978): Mauritius, *s.col.* (BM!)] . . . . . *Graphis turgidula* Müll. Arg.

C. Ascospores 4–8 per ascus, 15–19-septate, 65–100 × 9–12 µm [holotype: Philippines, *Merrill* 7958 (TUR-Vainio 27867!)] . . . . . *Graphis marginifera* Vain.

D. Ascospores 4–8 per ascus, 9–17-septate, 40–80 × 9–12 µm [holotype: Philippines, *Merrill* 7985 (TUR-Vainio 27863!)] . . . . . *Graphis tonglonensis* Vain.

E. Ascospores 4–8 per ascus, 13–19-septate, 80–120 × 11–15 µm [holotype: Indonesia (Celebes), *Kjellberg* 3L (S-2178!)] . . . . . *Graphis kjellbergii* Redinger

Notes. There is a probably undescribed species from Taiwan with similar lirellae anatomy and chemistry but with very long and radiately branched lirellae.

Lirellae immersed to erumpent, with lateral or apically thick complete thallin margin (*caesiella*- or *subserpentina*-morph) 6

6 (5) Ascospores medium-sized (50–70 × 7–11 µm); lirellae with lateral thalline margin, labia thinly white-pruinose (*caesiella*-morph); Eastern Palaeotropics . . . . . **Graphis subassimilis Müll. Arg.**

A. Ascospores 9–17-septate, 50–70 × 7–10 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): Indonesia (Java), *L. B.* 445 (L!; isolectotype: G!)] . . . . . *Graphis subassimilis* Müll. Arg.

B. Ascospores 13–17-septate, 55–70 × 9–11 µm [type: Indonesia (Java), *Overeem* s.n. (W, not seen; Hale Index Cards)] . . . . . *Graphis overeemii* Zahlbr.

C. Ascospores 11–15-septate, 45–65 × 7–11 µm [holotype: Taiwan, *Faurie* 243 (W!)] . . . . . *Graphis formosana* Zahlbr.

Ascospores large (70–90 × 10–14 µm); lirellae with apically thick complete thalline margin (*subserpentina*-morph); Palaeotropics [holotype: Tanzania, *Schröder* 160 (W!)] . . . . . **Graphis schroederi Zahlbr.**

Notes. According to the original description and the information provided by Redinger (1935), *Graphis balansana* Müll. Arg. might represent an earlier name for *G. schroederi*, but we have not seen type material of the former.

7 (4) Lirellae sessile, lacking or with basal thalline margin, very short and unbranched (*nuda*-morph); ascospores 100–200 µm long; Neotropics [holotype: Ecuador (Galápagos), *Bungartz* 4701 (CDS!)] . . **Graphis pedunculata Bungartz & Aptroot**

Lirellae erumpent to prominent, with basal to complete thalline margin (*hossei*-, *marginata*-, or *subserpentina*-morphs); ascospores 45–120 µm long 8

8 (7) Ascospores 60–120 µm long; lirellae prominent, with thick lateral thalline margin, elongate and irregularly branched (*marginata*-morph); norstictic acid; pantropical . . . . . **Graphis marginata Raddi**

A. Lirellae with thick lateral thalline margin; ascospores 4–8 per ascus, 11–25-septate, 60–120 × 9–18 µm [holotype: Brazil, *s.col.* (not seen; Adawadkar & Makhija 2006)] . . *Graphis marginata* Raddi

B. Lirellae with thick lateral thalline margin; ascospores 8 per ascus, 15–29-septate, 60–120 × 10– 17 µm [lectotype (Archer 2006): Indonesia (Borneo), *Beccari* 134 (M!)] . . *Graphis leucoparypha* Kremp.

C. Lirellae with thick lateral thalline margin; ascospores 8 per ascus, 15–19-septate, 60–85 × 10–12 µm [holotype: Australia, *Streimann* 56877 (CANB!)] *Graphis turgidula* var. *norstictica* A. W. Archer

Notes. If lirellae with thick white pruina and ascospores I–, cf. *Carbacanthographis induta* (Müll. Arg.) Lücking*.

Ascospores 45–70 µm long; lirellae erumpent, if prominent then with basal thalline margin (*hossei*-morph); norstictic or salazinic acid 9

9 (8) Disc exposed, white-pruinose (*scripta*-morph); lirellae otherwise with complete thalline margin; norstictic acid; Eastern Palaeotropics [holotype: India, *Patwardhan & Nagarkar* 73.2254 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . **Graphis albidofarinacea Adaw. & Makhija**

Disc concealed, labia non-pruinose 10

10(9) Lirellae prominent, with basal thalline margin, short and sparsely branched (*hossei*-morph); norstictic acid; Eastern Palaeotropics [holotype: India, *Nagarkar & Patwardhan* 85.1526 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . **Graphis kollaimalaiensis Adaw. & Makhija**

Lirellae erumpent, with thick lateral to complete thalline margin (*subserpentina*-morph) 11

11(10) Lirellae with thick lateral thalline margin; norstictic acid; Eastern Palaeotropics [holotype: India, *Nagarkar & Gole* 76.623 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . **Graphis nigrocarpa Adaw. & Makhija**

Lirellae with complete thalline margin; salazinic and stictic acids; Eastern Palaeotropics [holotype: India, *Patwardhan & Nagarkar* 77.1334 (AMH, photograph seen; Nagarkar & Patwardhan 1982; Awasthi 1991)] . . . . . **Graphis assamensis Nagarkar & Patw.**

12(3) Ascospores large (70–300 µm) 13

Ascospores medium-sized (40–70 µm) 19

13(12) Lirellae sessile, lacking thalline margin, very short and unbranched (*nuda*-morph) 14

Lirellae prominent to sessile, with basal to (thick) lateral or complete thalline margin (rarely thalline margin flaking off to expose black labia), short to elongate and sparsely to irregularly branched 15

14(13) Ascospores 15–21-septate, 80–100 µm long; Neotropics and Eastern Palaeotropics [holotype: China, *Handel-Mazzetti* 12262 (W!; isotype: US!)] . . . **Graphis bifera Zahlbr.**

Notes. According to Nakanishi *et al.* (2003*b*), *Graphis subdura* M. Nakan. would key out in our treatment as either a synonym of *G. bifera* or *G. adpressa*, depending on the length of the ascospores; we have not seen the original publication or type, but the ascospores of *G. subdura* are given by Nakanishi *et al.* (2003*b*) as either less than 60 µm or more than 65 µm.

Ascospores 25–31-septate, 100–140 µm long; Eastern Palaeotropics [holotype: Indonesia (Java), *s.col.* (W, not seen; Hale Index Cards)] . . **Graphis curtiuscula Zahlbr.**

15(13) Lirellae prominent, with basal thalline margin, short and sparsely branched (*Opegrapha*-morph); Eastern Palaeotropics [holotype: Japan, *Yatabe* 256 (G!)] . . . . . **Graphis parallela Müll. Arg.**

Lirellae prominent to sessile, with complete thalline margin, elongate and irregularly branched 16

16(15) Ascospores very large (120–300 µm long); Neotropics . . . . . **Graphis tumidula (Fée) Spreng.**

A. Thallus smooth to uneven [holotype: Peru, *s.col.* (G!)] . . . . . *Opegrapha tumidula* Fée

B. Thallus uneven to rugulose [holotype: South America, s.col. (G, not seen; Fée 1824, Tab. VII, Fig. 1, 1a; isotype: L!)] . . . . . *Opegrapha rugulosa* Fée

Ascospores large (70–130 µm long) 17

17(16) Lirellae sessile, very short to short and unbranched to rarely sparsely branched; thalline margin sometimes flaking off to expose black labia (*nudaeformis*-morph); Neotropics (Central America) [holotype: Costa Rica, *Lücking* 18025 (INB!)] . . . . . **Graphis nudaeformis Lücking**

Lirellae prominent, short to elongate and irregularly to stellately branched; thalline margin persistent 18

18(17) Lirellae short and stellately branched (*evirescens*-morph); Neotropics [holotype: Peru, *s.col.* (G, not seen; Fée 1824, Tab. XIII, Fig. 1, 1a; isotype: L!)] . . . . . **Graphis conglomerata Spreng.**

[≡ *Opegrapha conglomerata* Fée, nom. illeg., non Pers.]

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Lirellae elongate and irregularly branched (*rhizocola*-morph); Neotropics . . . . . **Graphis rhizocola (Fée) Lücking & Chaves**

A. Ascospores not seen [holotype: South America, *s.col.* (G, not seen; Fée 1824, Tab. XIII, Fig. 2, 2a)] . . . . . *Opegrapha rhizocola* Fée

B. Ascospores 11–19-septate, 70–100 × 10–20 µm [holotype: Peru, *s.col.* (not seen; Zenker 1829; Müller Argoviensis 1887)] . . . . . *Graphis cooperta* Zenker

C. Ascospores 19–25-septate, 70–130 × 11–20 µm [holotype: Caribbean (St. Vincent), *s.col.* (FH!)] . . . . . *Graphis anguilliformis* Taylor

D. Ascospores 15–25-septate, 70–130 × 11–20 µm [holotype: Brazil, *Glaziou* 6279 (G!)] . . . . . *Graphis serpens* Fée

E. Ascospores 13–19-septate, 70–120 × 10–20 µm [original material: Trinidad and Tobago (Trinidad), *Thaxter* 92 (TUR-Vainio 27529!)] . . . . . *Graphis anguillaeformis* var. *infecunda* Vain. [nom. inval. (not published)]

F. Ascospores 15–19-septate, 70–80 × 10–13 µm [holotype: Brazil, *Malme* 634 (S-6501!)] . . . . . *Graphis illota* var. *leopoldensis* Redinger

19(12) Lirellae prominent to sessile, lacking thalline margin or very rarely with basal thalline margin 20

Lirellae immersed to prominent, with basal to (thick) lateral thalline margin . . 23

20(19) Lirellae short and sparsely branched (*hossei*-morph); Eastern Palaeotropics [lectotype (here selected): Japan, *Yatabe* 260 (G, not seen; isolectotype: US!)] . . . . . **Graphis cognata Müll. Arg.**

Lirellae very short and unbranched (*nuda*-morph) 21

21(20) Ascospores grey-brown; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15247g (INB!; isotype: F!)] . . . . . **Graphis pittieri Lücking, Umaña, Sipman & Chaves**

Ascospores hyaline 22

22(21) Ascospores with terminal gelatinous caps, 40–60 × 8–13 µm; Neotropics . . . . . **Graphis ovata (Fée) A. Massal.**

A. Ascospores 9–11-septate, 40–60 × 10–12 µm [holotype: Peru, *s.col.* (G!)] . *Opegrapha ovata* Fée

B. Ascospores 7–11-septate, 40–50 × 8–13 µm [original material: Brazil, *Kalb & Plöbst* 31277 (hb. Kalb!)] . . . . . *Graphis nuda* Staiger [nom. inval. (not validly published)]

Ascospores lacking gelatinous caps, 50–70 × 12–15 µm; Neotropics [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27851!)] . . . . . **Graphis adpressa Vain.**

Notes. According to Nakanishi *et al.* (2003*b*), *Graphis subdura* M. Nakan. would key out in our treatment as either a synonym of *G. bifera* or *G. adpressa*, depending on the length of the ascospores; we have not seen the original publication or type, but the ascospores of *G. subdura* are given by Nakanishi *et al.* (2003*b*) as either less than 60 µm or more than 65 µm.

23(19) Lirellae very short and unbranched (*subregularis*- or *dussii*-morph) 24

Lirellae elongate and irregularly branched 25

24(23) Lirellae erumpent with basal thalline margin (*subregularis*-morph); Neotropics and Eastern Paleotropics [lectotype (here selected): South America, *s.col.* (G; Fée 1824, Tab. VI, Fig. 3 and 3a); Müller Argoviensis 1887)] . . . . **Graphis subimmersa (Fée) A. Massal.**

Lirellae prominent with thick lateral thalline margin (*dussii*-morph); Eastern Palaeotropics [holotype: Indonesia (Java), *s.col.* (G!)] . . . . . **Graphis regularis Müll. Arg.**

25(23) Lirellae immersed to erumpent, with lateral thalline margin, elongate and irregularly branched (*deserpens*-morph); Eastern Palaeotropics . . . . . **Graphis subdisserpens Nyl.**

A. Ascospores 9–17-septate, 40–70 × 6–10 µm [holotype: India, *Kurz* 37 (H-Nylander 7156!)] . . . . . *Graphis subdisserpens* Nyl.

B. Ascospores 13–15-septate, 45–65 × 8–12 µm [holotype: Australia, *Hartmann* 77 (G!; isotype: MEL!)] . . . . . *Graphis propinqua* Müll. Arg.

C. Ascospores 11–15-septate, 55–70 × 6–8 µm [holotype: India, *Patwardhan & Adawadkar* 87.314 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . *Graphis dispersa* Makhija & Adaw. [nom. illeg., non Redinger]

Notes. *Graphis propinqua* was treated as a separate species by Archer (2006) but is identical with *G. subimmersa*.

Lirellae prominent, with (thick) lateral to complete thalline margin 26

26(25) Labia white pruinose along slit (*farinulenta*-morph); thallus usually matt, ecorticate; pantropical . . . . . **Graphis seminuda Müll. Arg.**

A. Lirellae prominent; ascospores 11–13-septate, 40–65 × 8–11 µm [lectotype (Lücking *et al.* 2008): Costa Rica, *Pittier* 5241 (G!)] . . . . . *Graphis seminuda* Müll. Arg.

B. Lirellae (erumpent to) prominent; ascospores 11–15-septate, 45–65 × 8–11 µm [lectotype (Lücking *et al.* 2008): Costa Rica, *Pittier* s.n. (G!)] . . . . . *Graphis seminuda* var. *sublaevis* Müll. Arg.

C. Lirellae (erumpent to) prominent; ascospores 11–15-septate, 45–70 × 8–11 µm [holotype: Australia, *Streimann* 28307 (CANB!)] . . . . . *Graphis catherinae* A. W. Archer

Labia non-pruinose; thallus slightly nitidous 27

27(26) Lirellae prominent, with thick lateral thalline margin, elongate and irregularly branched (*marginata*-morph); pantropical . . . . **Graphis flavens Müll. Arg.**

A. Ascospores 11–15-septate, 50–70 × 9–11 µm [holotype: Indonesia (Java), *Junghuhn* 446 (L!; isotype: G!)] . . . . . *Graphis flavens* Müll. Arg.

B. Ascospores 13–19-septate, 60–80 × 10–14 µm [holotype: Guadeloupe, *Duss* 530 (TUR-Vainio 27845!)] . . . . . *Graphis angustata* var. *denudata* Vain.

C. Ascospores 13–19-septate, 60–80 × 7–11 µm [holotype: Indonesia (Java), *Kjellberg* 101L (S-2166!)] . . . . . *Graphis subintegra* Redinger

D. Ascospores 9–15-septate, 40–60 × 7–12 µm [original material: not designated] . . . . . *Graphis atrolabiata* Chaves & Lücking [nom. inval. (not published)]

Lirellae erumpent to prominent, with complete thalline margin 28

28(27) Lirellae with apically thin complete thalline margin, very long and radiately branched (*anguilliradians*-morph); Neotropics [holotype: Trinidad and Tobago (Trinidad), *Imshaug & Imshaug* 31858 (MSC-0024122!)] . . . . . **Graphis anguilliradians Lücking**

Lirellae with apically thick complete thalline margin, short and sparsely branched (*illinata*-morph); Eastern Paleotropics [holotype: Australia, *Archer* 747 (NSW!)] . . . . . **Graphis subcelata A. W. Archer**

29(1) Norstictic, salazinic, and/or stictic acid (K+ yellow or K+ yellow forming red crystals) 30

Notes. If protocetraric acid (P+ red), cf. *Carbacanthographis hertelii* Kalb & Staiger.

No substances (K−) 43

30(29) Stictic acid (K+ yellow) 31

Norstictic and/or salazinic acid, sometimes additionally stictic acid (K+ yellow forming red crystals) 36

31(30) Disc exposed, white-pruinose (*scripta*-morph); Palaeotropics [type: Solomon Islands, *s.col.* (W!)] . . . . . **Graphis modesta Zahlbr.**

Disc concealed 32

32(31) Lirellae with thick complete thalline margin (labia with conspicuous white cover); Eastern Palaeotropics [holotype: Solomon Islands, *Hill* 8400 (BM!)] . . . . . **Graphis discarpa A. W. Archer**

Lirellae with (thick) lateral thalline margin; labia black or white-pruinose. . . . 33

Notes. If ascospores I− and lirellae with thick pruinose cover, cf. *Carbacanthographis stictica* Staiger.

33(32) Labia white-pruinose (*caesiella*- or *glaucescens*-morph) 34

Labia non-pruinose 35

34(33) Thallus ecorticate (*glaucescens*-morph); Neotropics [holotype: Mexico, *Pringle* 24 (W!)] . . . . . **Graphis subamylacea Zahlbr.**

Thallus corticate; lirellae with split between labia and thalline margin; Neotropics [holotype: Antilles (Dominica), *Imshaug* 32724B (MSC!)] . . . . . **Graphis imshaugii M. Wirth & Hale**

35(33) Lirellae very long and radiately branched, lateral thalline margin thin (*centrifuga*-morph); Neotropics and Eastern Palaeotropics [holotype: India, *Nagarkar & Sethy* 85.2264 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . **Graphis flavovirens Makhija & Adaw.**

Lirellae elongate and irregularly branched, lateral thalline margin thick (*subserpentina*-morph); Neotropics (Antilles) and Eastern Palaeotropics (Australia) [holotype: Australia, *Knight* 339 (G!)] . . . . . **Graphis descissa Müll. Arg.**

Notes. *Graphis ocellata* Zahlbr. may belong here but we have not been able to track down the type material.

36(30) Lirellae prominent, lacking thalline margin, very short and unbranched (*nuda*-morph); norstictic acid; pantropical [holotype: Australia, *Bailey* 217 (G!)] . . . . . **Graphis emersa Müll. Arg.**

A. Ascospores 7–11-septate, 30–40 × 7–9 µm [holotype: Australia, *Bailey* 217 (G!)] . . . . . *Graphis emersa* Müll. Arg.

B. Ascospores 7–9-septate, 25–35 × 7–8 µm [holotype: Japan (HIRO, not seen; Nakanishi 1966, 1967; Nakanishi *et al.* 2003*b*)] . . . . . *Graphis meridionalis* M. Nakan.

Lirellae immersed to erumpent, with lateral to apically thin complete thalline margin or rarely lacking thalline margin 37

37(36) Norstictic acid, additionally with salazinic and/or stictic acid 38

Norstictic or salazinic acid only 40

38(37) Lirellae erumpent, lacking thalline margin, short and sparsely branched (*subregularis*-morph); norstictic and salazinic acids; Eastern Palaeotropics [holotype: India, *Patwardhan & Prabhu* 75.184 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . **Graphis cinnamomea Adaw. & Makhija**

Lirellae immersed to erumpent, with lateral thalline margin; norstictic and stictic acids 39

39(38) Lirellae erumpent, with thick lateral thalline margin, elongate and irregularly branched (*subserpentina*-morph); ascospores 25–45 µm long; Eastern Palaeotropics [holotype: India, *Patwardhan & Prabhu* 75.220 (AMH, photograph seen; Awasthi 1991)] . . . . . **Graphis asahinae Patw. & C. R. Kulk.**

Lirellae immersed to erumpent, with lateral thalline margin, short and sparsely branched (*lineola*-morph); ascospores 15–25 µm long; Eastern Palaeotropics (often saxicolous) [holotype: Japan, *Yatabe* 266 (G, not seen; Staiger 2002)] . . . . . **Graphis cervina Müll. Arg.**

40(37) Salazinic acid; disc partly exposed (*handelii*-morph); Eastern Palaeotropics [holotype: Philippines, *Baker* 545 (TUR-Vainio 27868!; isotype: FH!)] . . . . **Graphis ficicola Vain.**

Norstictic acid; disc concealed 41

41(40) Labia white-pruinose (*caesiella*-morph); Neotropics and Eastern Palaeotropics (Papua New Guinea) [lectotype (Lücking *et al.* 2008): Brazil, *Malme* 3602 (S 6506!)] . . . . . **Graphis caesiocarpa Redinger**

Labia non-pruinose 42

42(41) Lirellae short, sparsely branched (*lineola*-morph); ascospores 30–45 µm long; Eastern Palaeotropics . . . . . **Graphis assimilis Nyl.**

A. Lirellae erumpent, with lateral thalline margin; excipulum (laterally to) completely carbonized; ascospores 7–11-septate, 30–45 × 7–9 µm [lectotype (Lücking *et al.* 2008): New Caledonia, *Viellard* s.n. (H-Nylander 7125!)] . . . . . *Graphis assimilis* Nyl.

B. Lirellae prominent, with thick lateral thalline margin; excipulum completely carbonized; ascospores 7–11-septate, 35–45 × 7–11 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): Indonesia (Java), *Van Overeem* s.n. (W!)] . . . *Graphis inamoena* Zahlbr.

C. Lirellae erumpent, with lateral thalline margin; excipulum completely carbonized; ascospores 7–9-septate, 30–40 × 6–8 µm [holotype: China, *Chung* 596f (W!)] . . . . . *Graphis spodoplaca* Zahlbr.

D. Lirellae erumpent, with thick lateral thalline margin; excipulum completely carbonized; ascospores 5–11-septate, 35–50 × 4–6 µm [holotype: India, *Patwardhan & Nagarkar* 85.1756 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . *Graphis verruciformis* Adaw. & Makhija

Notes. *Graphis inamoena* was treated as separate species by Archer (2006), but *G. assimilis* is an older name for this taxon. Lücking *et al.* (2008) listed *G. spodoplaca* as synonym of *G. tenellula* (= *G. cincta*), but the holotype has a completely carbonized excipulum and clear hymenium.

Lirellae elongate to very long and irregularly to radiately branched (*deserpens*- or *centrifuga*-morph); ascospores 15–30 µm long; pantropical . . . . . **Graphis intricata Fée**

A. Lirellae very long and radiately branched; ascospores 5–7-septate, 15–30 × 6–8 µm [lectotype: South America, *s.col.* (G!; isolectotype: H-Nylander 7142!)] . . . . . *Graphis intricata* Fée

B. Lirellae elongate and irregularly branched; ascospores 7-septate, 20-30 × 6–8 µm [holotype: New Zealand, *s.col.* (not seen; Hale Index Cards)] . . . . . *Graphis confinis* C. Knight & Mitt.

C. Lirellae elongate and irregularly branched; ascospores 5–7-septate, 20-30 × 6–8 µm [holotype: U.S.A. (Hawaii), *Rock* 99 (W!)] . . . . . *Graphis tapetica* Zahlbr.

D. Lirellae very long and radiately branched [holotype (saxicolous): China, *Handel-Mazzetti* 12233 (W, not seen; Zahlbruckner 1930)] . . . . . *Graphis hunana* Zahlbr.

E. Lirellae elongate and irregularly branched; ascospores 5–7-septate, 25–30 × 4–6 µm [holotype: India, *Patwardhan* 76.701 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . *Graphis colliculoides* Adaw. & Makhija

43(29) Lirellae immersed in pseudostromata, stellately branched (*hyphosa*-morph); labia white-pruinose; Neotropics . . . . . **Graphis hyphosa Staiger**

A. Ascospores 5–9-septate, 20–40 × 6–9 µm [holotype: Brazil, *Kalb* s.n. (hb. Kalb 28859; Staiger 2002)] . . . . . *Graphis hyphosa* Staiger

B. Ascospores 7–11-septate, 30–40 × 7–9 µm [lectotype (Lücking *et al.* 2008): Brazil, *Malme* 2357 (S 6499!)] . . . . . *Graphis intricata* f. *meizospora* Redinger

Lirellae erumpent to prominent, unbranched to irregularly branched, if stellately branched then not forming pseudostromata and labia non-pruinose 44

44(43) Lirellae sessile, lacking thalline margin, very short to short and unbranched to sparsely branched (*nuda*- or *hossei*-morph); pantropical . . . . . **Graphis conferta Zenker**

A. Ascospores 7–11-septate, 35–45 × 10–13 µm [holotype: Unknown locality, *s.col.* (not seen; Zenker 1829)] . . . . . *Graphis conferta* Zenker

B. Ascospores 7–11-septate, 25–45 × 7–10 µm [holotype: Brazil, *Puiggari* 337 (G!)] . . . . . *Graphis virescens* Müll. Arg.

Notes. Lücking *et al.* (2008) used the name *Graphis virescens* for this taxon, but *G. conferta* represents an earlier epithet.

Lirellae erumpent to prominent, with basal to lateral or complete thalline margin, short to elongate and sparsely to radiately or stellately branched 45

45(44) Lirellae with basal to lateral thalline margin 46
Lirellae with apically thin complete thalline margin or labia white-pruinose . . 50

46(45) Disc exposed; lirellae elongate and irregularly branched (*handelii*-morph); Eastern Palaeotropics [holotype: India, *Sethy & Patwardhan* 86.820 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . **Graphis palmicola Makhija & Adaw.** [non *Graphina palmicola* Müll. Arg.]
Disc concealed; labia variable 47

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47(46) Lirellae with basal to lateral thalline margin, short and stellately branched (*dracaenae*- or *stellata*-morph) 48
Lirellae with (thick) lateral thalline margin, short to elongate and sparsely to irregularly branched 49

48(47) Thallus verrucose, olive-green, with scattered isidia; lirellae with lateral thalline margin (*stellata*-morph); Neotropics and Eastern Palaeotropics (Thailand) [holotype: Brazil, *Cáceres & Lücking* s.n. (F!; isotype: URM!)] . . . . . **Graphis stellata Cáceres & Lücking**
Thallus smooth, white-grey, lacking isidia; lirellae with basal thalline margin (*geraensis*-morph); pantropical [holotype: Africa, *Welwitsch* 397 (TUR-Vainio 27561!)] . . . . . **Graphis dracaenae Vain.**
A. Ascospores 5–7-septate, 20–30 × 5–7 µm [holotype: Africa, *Welwitsch* 397 (TUR-Vainio 27561!) . . . . . *Graphis dracaenae* Vain.
B. Ascospores 5–9-septate, 20–40 × 5–7 µm [holotype: Brazil, *Malme* 320 (S 6503!)] . . . . . *Graphis geraensis* Redinger
Notes. The concept of *Graphis geraensis* provided by Lücking *et al.* (2008) turned out to be incorrect; the material identified as such from Costa Rica is conspecific with *G. conferta*, whereas the type of *G. geraensis* is conspecific with *G. dracaenae*.

49(47) Lirellae prominent, with thick lateral thalline margin, elongate and irregularly branched (*marginata*-morph); pantropical . . . **Graphis oxyclada Müll. Arg.**
A. Ascospores 9–11-septate, 30–45 × 5–7 µm [holotype: Kenya, *Hildebrandt* 2540 (G!)] . . . . . *Graphis oxyclada* Müll. Arg.
B. Ascospores 7–9-septate, 30–35 × 5–7 µm [holotype: Sierra Leone, *Deighton* M-5539 (FH!)] . . . . . *Graphis njalensis* C. W. Dodge
Lirellae erumpent, with lateral thalline margin, short to elongate and sparsely to irregularly branched (*lineola*- or *deserpens*-morph); pantropical . . . . . **Graphis immersicans A. W. Archer**
A. Ascospores 5–7-septate, 20–30 × 5–8 µm µm [holotype: Philippines, *Elmer* 14926 (TUR-Vainio 27678!)] . . . . . *Graphis leptocarpa* var. *invita* Vain.
B. Ascospores 5–7-septate, 20–30 × 6–8 µm [holotype: Australia, *Streimann* 31317 (CANB!; isotypes: B!, H!, US!)] . . . . . *Graphis immersicans* A. W. Archer
Notes. Graphis immersicans and *G. dracaenae* are kept separate here due to the stellately branched lirellae with basal thalline margin observed in the latter. More material is necessary to confirm these differences.

50(45) Labia white-pruinose; lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*farinulenta*-morph); thallus matt; ascospores 3– 5-septate; Neotropics and African Palaeotropics . . . . . **Graphis sitiana Vain.**
A. Ascospores 3–5-septate, 20–30 × 7–9 µm [holotype: Brazil, *Vainio* 533 (TUR-Vainio 27854!)] . . . . . *Graphis sitiana* Vain.
B. Ascospores 3–7-septate, 15–30 × 7–10 µm [holotype: Puerto Rico, *Fink* 1777 (MICH, not seen, Fink 1927)] . . . . . *Graphis albida* Fink
Labia non-pruinose; lirellae variable; thallus slightly nitidous 51

51(50) Labia very long and radiately branched (*anguilliradians*-morph); Neotropics [holotype: Brazil, *Cáceres & Lücking* 00-0655 (F!; isotype: URM!))] . . . . . **Graphis pernambucoradians Cáceres & Lücking**
Labia short and sparsely branched 52

52(51) Lirellae with apically thick complete thalline margin (*subserpentina*-morph); Neotropics [lectotype (Lücking *et al.* 2008): Brazil, *Spruce* 341 (H-Nylander 7138!)] . . . . . **Graphis subvirginea Nyl.**
Lirellae with apically thin complete thalline margin (*negrosina*-morph); Eastern Palaeotropics [holotype: Philippines, *Merrill* 6790 (TUR-Vainio 27630!)] . . . . . **Graphis negrosina (Vain.) Lücking***

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Group 9: Labia entire, excipulum completely carbonized, hymenium clear, ascospores muriform

1 Ascospores large (80–200 µm long) 2
Ascospores small to medium-sized (15–80 µm long) 20

2(1) Norstictic, stictic, salazinic, and/or protocetraric acids (K+ yellow or K+ yellow forming red crystals or P+ red) 3

Notes. If psoromic and subpsoromic acids (P+ yellow) and ascospores I−, cf. *Carbacanthographis hillii* (A. W. Archer) A. W. Archer; if protocetraric acid (P+ red) and lichexanthone (UV+ yellow) and ascospores I−, cf. *Carbacanthographis subalbotecta* Staiger.

No substances (K−, P−) 9

3(2) Stictic acid (K+ yellow) 4
Norstictic and/or protocetraric and/or salazinic acids (K+ yellow forming red crystals or P+ red) 5

4(3) Ascospores terminally muriform; lirellae prominent, with apically thin complete thalline margin (*negrosina*-morph); ascospores 11–15 µm broad; Neotropics (Central America) [holotype: Costa Rica, *Sipman* 48390a (INB!; isotype: B!)] . . . . . **Graphis subturgidula Lücking & Sipman**

Ascospores regularly muriform; lirellae prominent to sessile, with apically thick complete thalline margin (*illinata*-morph); ascospores 15–20 µm broad; Eastern Palaeotropics [holotype: Indonesia (Borneo), *Hale* 30435 (US!)] . . . . . **Graphis sarawakensis Hale ex Lücking***

Notes. If ascospores I− and 120–180 × 25–30 µm, thallus ecorticate and lirellae with pruinose cover, cf. *Carbacanthographis crassa* (Müll. Arg.) Staiger & Kalb; if lichexanthone present (UV+yellow), thallus ecorticate, and lirellae thickly white-pruinose with partially exposed disc, cf. *Diorygma confluens* (Fée) Kalb, Staiger & Elix and *D. epiglaucum* (Müll. Arg.) Kalb, Staiger & Elix.

5(3) Protocetraric acid, sometimes additionally norstictic and salazinic acids 6
Norstictic acid only 7

6(5) Protocetraric acid only; lirellae prominent, with thick lateral thalline margin, labia black, sharply delimited, short and sparsely branched (*marginata*-morph); ascospores 20–35 µm broad; Eastern Palaeotropics [holotype: Philippines, *Elmer* 14583 (TUR-Vainio 27233!)] . . . . . **Graphis elmeri Vain.**

Protocetraric, norstictic, and salazinic acids; lirellae sessile, with thick lateral thalline margin, very short and unbranched (*dussii*-morph); ascospores 15–20 µm broad; Australia [holotype: Australia, *Lumbsch* 5409c (CANB!)] . . . . . **Graphis lumbschii (A. W. Archer) A. W. Archer**

Notes. If protocetraric acid (P+ red) and lichexanthone (UV+ yellow), ascospores I−, and lirellae with distinct pruina, cf. *Carbacanthographis subalbotecta* Staiger; if thallus ecorticate and lirellae thickly white-pruinose with partially exposed disc, cf. *Diorygma reniforme* (Fée) Kalb, Staiger & Elix.

7(5) Ascospores terminally muriform; lirellae prominent, with apically thick complete thalline margin, elongate and irregularly branched (*illinata*-morph); Eastern Palaeotropics [holotype: Australia, *Streimann* 56768 (CANB!)] . . . . . **Graphis aquilonia (A. W. Archer) Staiger**

Notes. The reports of *Graphis aquilonia* from Costa Rica (Lücking *et al.* 2008) do not belong to that taxon but represent *G. norvestitoides* (see Group 18: 3b).

Ascospores regularly muriform; lirellae erumpent with thick complete thalline margin or sessile with thick lateral thalline margin and then short 8

8(7) Lirellae elongate and irregularly branched, erumpent, with thick complete thalline margin (*subserpentina*-morph); ascospores single, 25–35 µm broad; Eastern Palaeotropics (Australia) [holotype: Australia, *Elix* 37306 (CANB!)] . . . . . **Graphis cycasicola A. W. Archer & Elix**

Lirellae very short and unbranched, sessile, with thick lateral thalline margin (*dussii*-morph); ascospores 2–4 per ascus, 15–25 µm broad; pantropical (also saxicolous) . . . . . **Graphis cleistoblephara Nyl.**
A. Excipulum completely carbonized; ascospores 80–130 × 15–25 µm [holotype: China (Hong Kong), *s.col.* (H-Nylander 7589!)] . . . . . *Graphis cleistoblephara* Nyl.
B. Excipulum (laterally to) completely carbonized; ascospores 75–120 × 15–22 µm [lectotype (here selected): Taiwan, *Asahina* 300 (W!)] . . . . . *Graphina subpulicaris* Zahlbr.

9(2) Lirellae round, prominent to sessile, with complete thalline margin (*globosa*-morph); ascospores single. 10
Lirellae at least shortly elongate, otherwise variable; ascospores variable 12

10(9) Thallus with abundant, delicate isidia; Neotropics [holotype: Venezuela, *Hale* 42425 (US!)] . . . . . **Graphis isidiata (Hale) Lücking***
Thallus lacking isidia. 11

11(10) Ascospores 150–270 × 25–50 µm; Neotropics . . . . . **Graphis mexicana (Hale) Lücking, Lumbsch & Kalb**
A. Ascospores 150–200 × 35–40 µm [holotype: Mexico, *Nakanishi* 82 (US!)] . . . . . *Thelotrema mexicanum* Hale
B. Ascospores 150–270 × 25–50 µm [holotype: Ecuador, *Kalb* s.n. (hb. Kalb!)] . . . . . *Graphina muscicola* Kalb
C. Ascospores 160–260 × 30–40 µm [holotype: Brazil, *Aptroot* 41709 (ABL!)] . . . . . *Topeliopsis globosa* Aptroot
Ascospores 80–140 × 17–35 µm; Neotropics . . **Graphis globosa (Fée) Spreng.**
A. Thallus white-grey; ascospores 80–140 × 17–35 µm [lectotype (here selected, based on annotation by Singh in 1983): South America, *s.col.* (G!)] . . . . . *Opegrapha globosa* Fée
B. Thallus brown; ascospores 80–130 × 20–30 µm [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27168!)] . . . . . *Graphis hemisphaerica* Vain.

12(9) Lirellae very short and unbranched, prominent to sessile 13
Lirellae distinctly elongate, immersed to prominent 15

13(12) Lirellae lacking thalline margin (*nuda*-morph); Neotropics [holotype: Brazil, *Aptroot* 41545 (B!)] . . . . . **Graphis lourdesina Aptroot***
Lirellae with thick lateral thalline margin or with thick white cover differing from lateral thalline margin 14

14(13) Lirellae with apically thick thalline margin (*cleistomma*-morph); ascospores single, 120–180 × 30–40 µm; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 16579 (F!)] . . . . . **Graphis oryzaecarpa Lücking**
Lirellae with thick lateral thalline margin but lacking apical cover (*dussii*-morph); ascospores 1–2 per ascus; 80–120 × 10–20 µm; pantropical. . . . . **Graphis plagiocarpa Fée**
A. Ascospores 80–120 × 10–18 µm [holotype: Caribbean, *s.col.* (G!)] . . . *Graphis plagiocarpa* Fée
B. Ascospores 95–120 × 15–20 µm [holotype: Australia, *Streimann* 45427 (CANB!)]. . . . . *Graphina lumbschii* var. *deficiens* A. W. Archer

15(12) Lirellae immersed, with thick lateral thalline margin (*subserpentina*-morph); ascospores 2–4/ascus, (40–)80–90 × (16–)20–28 µm (see also 30b); Neotropics and Eastern Palaeotropics (Australia) . . . . . **Graphis dolichographa Nyl.**
Lirellae prominent, with basal or complete thalline margin; ascospores variable 16

16(15) Lirellae with basal thalline margin (*hossei*-morph); ascospores 80–90 µm long; Neotropics [holotype: America, *s.col.* (G, not seen; Hale Index Cards)] . . . . . **Graphis subvernicosa Lücking***
[≡ *Opegrapha vernicosa* Fée, non *Graphis vernicosa* Nyl.]

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Notes. If ascospores grey-brown and hymenium distinctly inspersed, cf. *Thecographa prosiliens* (Mont. & Bosch) A. Massal.

Lirellae with complete thalline margin; ascospores at least partly longer than 90 µm 17

17(16) Lirellae very short, unbranched, with apically thin complete thalline margin (*cleistomma*-morph); Neotropics [lectotype (here selected): Colombia, *Lindig* 2626 (H-Nylander 6054!)] . . . . . **Graphis cleistomma Nyl.**

Notes. There are three syntypes in hb. Nylander, all with the same collection number (*Lindig* 2626) but with different accession numbers (6054, 7533, 7534). The first two represent parts of the same collection and the well-developed 6054 is here selected as lectotype, although 7533 was annotated by Nakanishi in 1973 (but apparently not published).

Lirellae distinctly elongate, partly branched, with apically thin or thick thalline margin (*rhizocola*-or *illinata*-morph) 18

18(17) Ascospores single; lirellae with apically thick thalline margin (*illinata*-morph); Neotropics [lectotype (Wirth & Hale 1978): Brazil, *Martius* s.n. (M!)] . . . . . **Graphis illinata Eschw.**

Ascospores 2–4 per ascus 19

19(18) Lirellae with apically thin complete thalline margin (*rhizocola*-morph); large clusters of calcium oxalate crystals between lateral excipulum and covering thalline margin (see also Group 18: 8a); Neotropics and Eastern Palaeotropics . . . . . **Graphis acharii Fée**

A. Ascospores 80–170 × 15–30 µm [lectotype (Wirth & Hale 1978): Brazil, *Glaziou* 6286 (BM!; isolectotype: M!)] . . . . . *Graphis inturgescens* Kremp.

B. Ascospores 100–150 × 20–30 µm [syntypes: Mexico, *Pringle* 5, 25 (MICH, W, not seen; Wirth & Hale 1963)] . . . . . *Graphina acharii* var. *subintegra* Zahlbr.

Notes. We first considered *Graphis inturgescens* as a distinct species, but the type material agrees completely with non-striate, first-generation lirellae of *G. acharii*.

Lirellae with apically thick thalline margin (*illinata*-morph); no crystals between lateral excipulum and covering thalline layer; Neotropics [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27171!)] . . . . . **Graphis carassensis Vain.**

20(1) Norstictic, stictic, and/or protocetraric acids (K+ yellow or K+ yellow forming red crystals or P+ red) 21

Notes. If ascospores I− and salazinic acid present, cf. *Carbacanthographis salazinica* (A. W. Archer) A. W. Archer.

No substances (K−, P−) 24

Notes. If ascospores very small (6–12 µm long), submuriform, I−, cf. *Carbacanthographis coccospora* (Aptroot) Aptroot & Lücking*.

21(20) Protocetraric acid (P+ red); ascospores very small (15–20 µm long); lirellae prominent, with apically thin complete thalline margin (*negrosina*-morph); Eastern Palaeotropics [holotype: Solomon Islands, *Hill* 9367 (BM!)] . . . . . **Graphis subelmeri (A. W. Archer) A. W. Archer**

Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals); ascospores small to medium-sized (20–50 µm long); lirellae variable 22

22(21) Stictic acid (K+ yellow); lirellae prominent, lacking or with basal thalline margin (*hossei*-morph); Eastern Palaeotropics (China) [holotype: China, *Li Jing* FJI182 (LHS, not seen; Jia & Wei 2008)] . . . . . **Graphis fujianensis Z. F. Jia & J. C. Wei**

Norstictic acid (K+ yellow forming red crystals; lirellae erumpent to prominent, with lateral thalline margin 23

Notes. If salazinic acid, thallus ecorticate, lirellae prominent and white pruinose, and ascospores I−, cf. *Carbacanthographis amicta* (Nyl.) Staiger & Kalb.

23(22) Lirellae prominent, with apically thick complete thalline margin, very short and unbranched (*cleistomma*-morph); Eastern Palaeotropics [holotype: Papua New Guinea, *Aptroot* 38161 (B!)] . . . . . **Graphis nadurina Aptroot⋆**

Lirellae immersed, with lateral thalline margin; pantropical (also saxicolous) [holotype: U.S.A. (Hawaii), *Faurie* 720 (UPS, not seen; Magnusson 1955)] . . . . . **Graphis cremicolor (H. Magn.) Lücking & Archer**

24(20) Lirellae prominent to sessile, very short, usually unbranched 25

Lirellae immersed to erumpent, short to elongate, at least partly branched . . . 28

Notes. If disc exposed and brown pruinose, cf. *Glyphis atrofusca* (Müll. Arg.) Lücking⋆.

25(24) Lirellae with thick lateral thalline margin (*dussii*-morph); ascospores 2/ascus, 50–70 × 25–30 µm; Neotropics and Eastern Palaeotropics [holotype: South America, *s.col.* (H-Acharius 656!)] . . . . . **Graphis scaphella Ach.**

Lirellae lacking thalline margin (*nuda*-morph); ascospores variable 26

26(25) Ascospores 55–80 × 20–28 µm, 2–4 per ascus; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 17750gb (F!)] . . . . . **Graphis subruiziana Sipman, Chaves & Lücking**

Ascospores 25–65 × 10–20 µm, 4–8 per ascus 27

Notes. If ascospores 20–25 × 8–11 µm, cf. *Graphina hartmanniana* Müll. Arg., which is not a *Graphidaceae*; see Ertz & Diederich 2007.

27(26) Ascospores 25–40 µm long, 8 per ascus; Neotropics and Eastern Palaeotropics (Hawaii) [holotype: U.S.A. (Hawaii), *Faurie* 1025b (UPS!)] . . . . . **Graphis nuda (Magn.) Staiger & Lücking**

Ascospores 35–65 µm long, 4–8 per ascus; cosmopolitan [holotype: South America, *s.col.* (G!)] . . . . . **Graphis ruiziana (Fée) A. Massal.**

28(24) Ascospores single, (30–)50–70 × 15–30 µm; lirellae erumpent, with basal thalline margin, elongate and irregularly branched (*hossei*-morph); Eastern Palaeotropics [holotype: Philippines, *Robinson* 9083 (TUR-Vainio 27263!)] . . **Graphis polillensis Vain.**

Ascospores 2–8 per ascus; lirellae variable 29

29(28) Ascospores medium-sized (35–80 µm long) and broad (15–30 µm broad) . . . 30

Ascospores small (20–40 µm long) and narrow (10–12 µm broad) 31

30(29) Lirellae erumpent, with lateral thalline margin, very long and radiately branched (*centrifuga*-morph); ascospores 35–50 × 15–20 µm; Neotropics (Central America) [holotype: Costa Rica, *Will-Wolf* 12740a (CR!; isotypes: F!, INB!, USJ!, WIS!)] . . . . . **Graphis gomezii Lücking, Will-Wolf & Umaña**

Lirellae immersed, with thick lateral thalline margin and indistinctly delimited labia (*subserpentina*-morph); irregularly branched and shorter (up to 5 mm); ascospores 40–80(–90) × 16–28 µm (see also 15a); Neotropics and Eastern Palaeotropics (Australia) [holotype: Colombia, *Lindig* 866 (H-Nylander 6052!)] . . . . . **Graphis dolichographa Nyl.**

31(29) Lirellae erumpent, with apically thin complete thalline margin (upper part of labia dark grey), elongate and irregularly branched (*negrosina*-morph); Neotropics [holotype: Colombia, *Lindig* 2725 (H-Nylander 7408b!)] . . . **Graphis subtecta (Nyl.) Lücking⋆**

Lirellae with basal to lateral thalline margin or thalline margin lacking, upper part of labia black 32

32(31) Lirellae very long (up to 10 mm), radiately branched (*centrifuga*-morph); Neotropics [holotype: Brazil, *Puiggari* s.n. (G!)] . . . . . **Graphis jeanmuelleri Lücking⋆**
[≡ *Graphina elegantula* Müll. Arg., non *Graphis elegantula* Zahlbr.]

Lirellae rather short (1–3 mm), unbranched or sparsely branched 33

33(32) Ascospores 20–30 µm long; lirellae erumpent, with basal thalline margin, short and sparsely branched (*subregularis*-morph); African Palaeotropics [lectotype (here selected, lower middle piece extracted for TLC by Staiger in 1998): Guinea, *s.col.* (H-Acharius 628!)] . . . . . **Graphis comma (Ach.) Spreng.** [non Eschw.]

Notes. The species was reported from America by Fée (1824) but we could not verify that record.

Ascospores 30–40 µm long; lirellae with lateral thalline margin (*lineola*-morph); Eastern Palaeotropics [holotype: Solomon Islands, *Hill* 9821 (BM!)] . . . . . **Graphis maritima (A. W. Archer) A. W. Archer**

Group 10: Labia entire, excipulum completely carbonized, hymenium inspersed, ascospores transversely septate

1 Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals). 2
No substances 9

2(1) Stictic acid (K+ yellow); lirellae erumpent to prominent, with apically thin or thick complete thalline margin 3
Norstictic acid (K+ yellow forming red crystals); lirellae erumpent, with (thick) lateral thalline margin or thalline margin absent 5

3(2) Ascospores 5–7-septate, 25–35 × 6–8 µm; lirellae erumpent, with apically thin complete thalline margin (*negrosina*-morph); thallus verrucose; Eastern Palaeotropics [type: Solomon Islands (BM!)] . . . . . **Graphis luluensis A. W. Archer**
Ascospores 9–19-septate, 50–90 × 9–16 µm; lirellae variable 4

4(3) Lirellae prominent, short and sparsely branched, with apically thick complete thalline margin (*illinata*-morph); thallus uneven; Eastern Palaeotropics (Hawaii) [holotype: U.S.A. (Hawaii), *Rock* 131 (W!; isotype: FH!)] . . . . . **Graphis apoda (Zahlbr.) Lücking***
Lirellae erumpent to prominent, elongate and irregularly branched, with thick lateral thalline margin (*marginata*-morph); thallus smooth; Eastern Palaeotropics (Australia) [holotype: Australia, *Rogers* 7613 (BRI!)] . . . . . **Graphis gloriosensis A. W. Archer & Elix**

5(2) Disc exposed, white-pruinose, lirellae erumpent, with lateral thalline margin, short and sparsely branched (*scripta*-morph); ascospores 20–35 µm long; Palaeotropics . . . . . **Graphis aperiens Müll. Arg.**

A. Ascospores 5–9-septate, 20–30 × 6–9 µm [holotype: Japan, *Miyoshi* s.n. (G!)] . . . . . *Graphis aperiens* Müll. Arg.

B. Ascospores 5–7-septate, 20–35 × 6–9 µm [holotype: Australia, *Bailey* 488 (G!)]. . . . . *Graphis semiaperta* Müll. Arg.

Notes. Archer (2006) treated *Graphis semiaperta* a separate species but *G. aperiens* is an older name available for this taxon.

Disc concealed, labia non-pruinose; ascospores variable 6

6(5) Lirellae erumpent, lacking thalline margin, short to elongate and irregularly branched (*hossei*-morph); ascospores small to medium-sized (25–50 µm long); Neotropics and Eastern Palaeotropics [lectotype (Wirth & Hale 1978): Brazil, *Glaziou* 5082 (M!)] . . . . . **Graphis desquamescens (Fée) Zahlbr.**
[≡ *Graphis compulsa* Kremp. nom. illeg.]

Notes. Krempelhuber (1876) deliberately replaced the epithet *desquamescens* with *compulsa*, which is illegitimate, but the name change was accepted by Redinger (1935).

Lirellae erumpent, with lateral thalline margin; ascospores (very) small (15–30 µm long) 7

7(6) Lirellae very long and radiately branched (*centrifuga*-morph); ascospores very small (15–25 µm long); Eastern Palaeotropics [holotype: Australia, *Wilson* s.n. (H-Räsänen!)] . . . . . **Graphis centrifuga Räsänen**
Lirellae short and stellately branched or short to elongate and sparsely to irregularly or branched; ascospores small (20–30 µm long) 8

8(7) Lirellae short, stellately branched (*coarctata*-morph); Eastern Palaeotropics [holotype: Taiwan, *Faurie* 236 (W!)] . . . . . **Graphis cervinonigra Zahlbr.**
Lirellae short to elongate, sparsely to irregularly branched (*lineola*- or *deserpens*-morph); Palaeotropics . . . . . **Graphis gonimica Zahlbr.**
A. Lirellae short, sparsely branched [lectotype (here selected, based on annotation label by Nakanishi in 1973): China, *Chung* 591a (W!)] . . . . . *Graphis gonimica* Zahlbr.
B. Lirellae elongate, irregularly branched [lectotype (here selected, based on annotation label by Nakanishi in 1973): China, *Handel-Mazzetti* 12819 (W!; isolectotype: S 2169!)] . . . . . *Graphis sapii* Zahlbr.
C. Lirellae short, sparsely branched [holotype: Australia, *Stevens* s.n. (BRI!)] . . . . . *Graphis eimeoensis* A. W. Archer & Elix
Notes. The type material of *Graphis sapii* also contains *G. pinicola* and *G. tsunodae*.

9(1) Ascospores large (70–135 × 9–30 µm) 10
Ascospores small to medium-sized (25–70 × 6–9 µm) 12

10(9) Lirellae erumpent, with complete thalline margin (*subserpentina*-morph); hymenial inspersion of type A; African Palaeotropics [holotype: Tanzania, *Holst* s.n. (G!)] . . . . . **Graphis superans Müll. Arg.**
Lirellae prominent, with apically thin complete thalline margin (*negrosina*-morph); hymenial inspersion of type B 11

11(10) Ascospores 11–15 µm broad; Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15449a (INB!)] . . . . . **Graphis bettinae Lücking, Umana, Chaves & Sipman**
Ascospores 20–30 µm broad; South America [holotype: Brazil, *Kalb* 31118 (hb. Kalb; Staiger 2002)] . . . . . **Graphis subserpens Staiger***

12(9) Ascospores medium-sized (60–70 µm long), 13–17-septate; lirellae prominent, with basal thalline margin (*hossei*-morph); Neotropics [holotype: Cuba, *Ekman* 19 (TUR-Vainio 27371!)] . . . . . **Graphis cupei Vain. ex Lücking***
Ascospores small (25–45 µm long), 7–11-septate; lirellae variable 13

13(12) Lirellae prominent, lacking thalline margin, short and sparsely branched (*hossei*-morph); possibly pantropical [lectotype (Wirth & Hale 1978): Brazil, *Martius* s. n. (M!; isolectotype: G!)] . . . . . **Graphis anfractuosa (Eschw.) Eschw.**
Lirellae erumpent, with lateral thalline margin, very long and radiately branched (*centrifuga*-morph); Palaeotropics [holotype: Thailand, *Schmidt* s. n. (TUR-Vainio 27563!)] . . . . . **Graphis arbusculaeformis (Vain.) Lücking***

Group 11: Labia entire, excipulum completely carbonized, hymenium inspersed, ascospores muriform

1 Ascospores terminally muriform; lirellae prominent, with apically thin complete thalline margin (upper part of labia dark grey), elongate and irregularly branched (*negrosina*-morph) (see also Group 20: 1a); Neotropics (Central America) . . . . . **Graphis subflexibilis Lücking & Chaves**
Ascospores regularly muriform 2

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2(1) Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals) 3
Notes. If protocetraric acid and ascospores I−, 14–18 × 5–7 µm, cf. *Carbacanthographis inspersa* Staiger.
Hirtifructic acid or no substances (K−) 6

3(2) Stictic acid (K+ yellow); lirellae prominent, with apically thin complete thalline margin (*negrosina*-morph); Neotropics (Central America) [holotype: Costa Rica, *Sipman* 48189 (INB!; isotype: B!)] . . . . . **Graphis inspersostictica Sipman & Lücking**
Norstictic acid (K+ yellow forming red crystals); lirellae erumpent to prominent, with thick lateral thalline margin 4

4(3) Ascospores single, 100–150 × 25–40 µm; lirellae erumpent, with thick lateral thalline margin, elongate and irregularly branched (*subserpentina*-morph); pantropical [holotype: Australia, *Sayer* s.n. (G!)] . . . . . **Graphis novopalmicola A. W. Archer & Lücking***
[≡ *Graphina palmicola* Müll. Arg., non *Graphis palmicola* Makhija & Adaw.]
Ascospores 1–4 per ascus, 40–110 × 15–30 µm 5

5(4) Ascospores 1–2 per ascus, 60–110 µm long; lirellae prominent, with thick lateral thalline margin, very short and unbranched (*dussii*-morph); pantropical [lectotype (Staiger 2002): Sri Lanka, *Almquist* 1879 (H-Nylander 7398!)] . **Graphis leprographa Nyl.**
Ascospores (2–)4 per ascus, 40–55 µm long; lirellae erumpent, with thick lateral thalline margin, short and sparsely branched (*subserpentina*-morph); Eastern Palaeotropics (Australia) [holotype: Australia, *Hartmann* s.n. (G!)] . . . . . **Graphis saxicola (Müll. Arg.) A. W. Archer**

6(2) Ascospores single; lirellae with apically thick complete thalline margin (*illinata*-morph); hirtifructic acid; Australia [holotype: Australia, *Elix* 16321 (CANB!)] . . . . . **Graphis elixiana A. W. Archer**
[≡ *Phaeographis elixii* A. W. Archer, non *Graphis elixii* A. W. Archer]
Ascospores (1–)2–8 per ascus; lirellae with apically thin complete thalline margin (*negrosina*-morph); no substances 7

7(6) Ascospores 15–25 µm broad, 4–8 per ascus (see also Group 20: 5) . . . . . **Graphis argentata Lücking & Umaña**
Ascospores 25–35 µm broad, 1–4 per ascus (see also Group 20: 5); Neotropics [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27166!)] . . . . . **Graphis phaeospora Vain.**

Group 12: Labia striate, excipulum apically and basally carbonized, interrupted by lateral non-carbonized parts, hymenium clear, ascospores transversely septate to muriform

1 Ascospores distinctly muriform, single, 150–180 × 30–45 µm (often grey-brown when old but I+ violet); lirellae prominent, with apically thin complete thalline margin (upper part of labia dark grey); elongate and irregularly branched (*acharii*-morph); Neotropics (Central America) [holotype: Costa Rica, *Sipman* 48208 (INB!; isotype: B!)] . . . . . **Graphis mirabilis Lücking, Sipman, Umaña & Chaves**
Ascospores transversely septate or with occasional longitudinal septa in some of the segments, 2–8 per ascus, 45–110 × 10–14 µm; lirellae immersed to erumpent, with apically thin complete thalline margin (*symplecta*-morph) 2

2(1) Ascospores transversely septate, 45–80 µm long; lirellae erumpent; Neotropics (Central America) and Asian Palaeotropics [holotype: Costa Rica, *Sipman* 51764 (INB!; isotype: B!)] . . . . . **Graphis gregmuelleri Sipman & Lücking**

Ascospores with a few longitudinal septa, 60–110 µm long; lirellae immersed; Neotropics (South America) [holotype: Paraguay, *Balansa* s.n. (G!)] . . . . . **Graphis immersoides Lücking**
[≡ *Graphina immersa* Müll. Arg., non *Graphis immersa* Fink]

Group 13: Labia striate, excipulum apically (to peripherally) carbonized, hymenium clear, ascospores transversely septate

1 Norstictic and/or stictic acid (K+ yellow or K+ yellow forming red crystals) . . . 2
No substances (K−) 10

2(1) Norstictic acid, sometimes additionally stictic acid (K+ yellow forming red crystals) 3
Stictic acid only (K+ yellow) 7

3(2) Ascospores large (75–100 µm long) 4
Ascospores small to medium-sized (20–60 µm long) 5

4(3) Norstictic acid only; lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Eastern Palaeotropics [holotype: Thailand, *Hosseus* s.n. (TUR-Vainio 27801!)] . . . . . **Graphis trichospora Vain.**

Notes. Graphis trichospora, G. verminosa, and *G. leptospora* share the same lirellae morphology, ascospore type and chemistry, but differ in the degree of excipulum carbonization (apical *versus* lateral *versus* complete). As in other cases, and contrary to other authors, we consider these to represent distinct species, but the available material is sparse and the variation in excipulum carbonization cannot be properly assessed at this point.

Norstictic and stictic acids; lirellae erumpent, with apically thin complete thalline margin (upper part of labia dark grey), elongate and irregularly branched (*symplecta*-morph); Eastern Palaeotropics [holotype: India, *Patwardhan & Nagarkar* 77.1115 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis meghalayaensis Adaw. & Makhija**

5(3) Lirellae immersed, with lateral thalline margin; labia white-pruinose (*glaucescens*-morph); norstictic acid only; Palaeotropics . . . . . **Graphis exalbata Nyl.**

A. Excipulum apically (to laterally) carbonized; ascospores 7–11-septate, 25–45 × 6–9 µm [lectotype (based on annotation label by Awasthi & Mathur 1989): São Tomé and Principe, *Fr. Quintas* s. n. (H-Nylander 7661!)] . . . . . *Graphis exalbata* Nyl.

B. Excipulum apically carbonized; ascospores 7–11-septate, 20–50 × 6 µm [holotype: India (AMH, not seen; Makhija *et al.* 2006; Adawadkar & Makhija 2007)] . . . . . *Graphis nerurensis* Makhija, A. Dube, Adaw. & Chitale

Lirellae erumpent to prominent, with basal thalline margin or lacking thalline margin; labia non-pruinose; norstictic, stictic, and constictic acids 6

6(5) Lirellae erumpent, lacking thalline margin, elongate and irregularly branched (*striatula*-morph); ascospores 30–60 µm long; Eastern Palaeotropics [lectotype (Awashti & Singh 1975): India, *Thwaites* 82 (BM, not seen; Awasthi & Singh 1975)] . . . . . **Graphis nigroglauca Leight.**

Notes. This species has also been reported as having an inspersed hymenium, but we have not been able to study the type and confirm this feature; inspersed hymenia are extremely rare in species with *striatula*-morph lirellae.

Lirellae prominent, with basal thalline margin, short and sparsely branched (*striatula*-morph); ascospores 25–35 µm long; Eastern Palaeotropics [holotype: India, *Nagarkar & Sethy* 81.508 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis subvittata Adaw. & Makhija**

7(2) Ascospores medium-sized to large (60–160 × 12–16 µm), 2–4 per ascus; labia pruinose; lirellae erumpent, lacking thalline margin, elongate and irregularly branched (*albotecta*-morph); Eastern Palaeotropics . . . . **Graphis sp. 1** in Awasthi (1991)
Ascospores small to medium-sized (20–60 × 6–10 µm), 8/ascus; labia non-pruinose; lirellae variable 8

8(7) Thallus isidiate; lirellae erumpent, with complete thalline margin; ascospores 20–35 µm long; Eastern Palaeotropics [India, *Makhija* 01.106 (AMH, photograph seen; Adawadkar & Makhija 2004)] . . . . . **Graphis isidiza Adaw. & Makhija**
Thallis lacking isidia; lirellae variable; ascospores variable 9

9(8) Lirellae erumpent, with lateral thalline margin; ascospores 30–50 µm long; pantropical . . . . . **Graphis vittata Müll. Arg.**
A. Ascospores 7–11-septate, 30–50 × 7–8 µm [holotype: Indonesia, *Junghuhn* 111 (Java) (G!)] . . . . . *Graphis vittata* Müll. Arg.
B. Ascospores 7–11-septate, 30–40 × 7–10 µm [holotype: Indonesia (Java), *Van Overeem* 93 (W!)] . . . . . *Graphis treubii* Zahlbr.
C. Ascospores 7–11-septate, 30–40 × 7–10 µm [holotype: China, *Handel-Mazzetti* 11217 (W!;isotype: US!)] . . . . . *Graphis theae* Zahlbr.
D. Ascospores 7–9-septate, 30–35 × 6–8 µm [holotype: Taiwan, *Asahina* 368 (W!)] . . . . . *Graphis flabellans* Zahlbr.
Notes. Archer (2006) maintained *Graphis treubii* separate from *G. vittata* but reexamination of the types confirmed conspecificity of the two taxa.
Lirellae erumpent to prominent, lacking thalline margin, short and sparsely branched (*striatula*-morph); ascospores 20–40 µm long; pantropical [lectotype (Archer 2006): Philippines, *Fénix* 12786 (TUR-Vainio 27887!)] . . **Graphis stenotera Vain.**

10(1) Ascospores medium-sized to large (50–125 µm long) 11
Ascospores small (20–50 µm long) 15

11(10) Thallus isidiate; lirellae erumpent, with lateral thalline margin, very long and radiately branched (*dichotoma*-morph); ascospores 9–19-septate, 60–110 × 8–12 µm; Eastern Palaeotropics [holotype: India, *Prabhu & Nagarkar* 74.3534 (AMH, photograph seen; isotype: US!)] . . . . . **Graphis patwardhanii C. R. Kulk.**
Thallus lacking isidia; lirellae variable; ascospores variable 12

12(11) Ascospores large (80–125 µm long) 13
Ascospores medium-sized (50–70 µm long) 14

13(12) Thallus white-grey; lirellae erumpent, with lateral thalline margin (*tenella*-morph) and distinct white lines inbetween striae, formed by clusters of calcium-oxalate crystals; Neotropics [holotype: Guadeloupe, *Duss* 517 (TUR-Vainio 27847!)] . . . . . **Graphis subalbostriata Lücking***
[≡ *G. angustata* var. *albostriata* Vain., non *G. albostriata* Vain.]
Thallus dark olive-grey; lirellae erumpent, with apically thin complete thalline margin, elongate and irregularly branched (*symplecta*-morph); pantropical [holotype: Brazil, *Malme* 2267B (S-2170!)] . . . . . **Graphis olivacea Redinger**

14(12) Thallus yellow-green; labia non-pruinose; lirellae prominent, lacking thalline margin, elongate and irregularly branched (*striatula*-morph); Neotropics (Central America, Caribbean) [holotype: Dominica, *Imshaug & Imshaug* 32777-A2 (MSC!)] . . . . . **Graphis caribica Lücking**
Thallus white-grey; labia white-pruinose; lirellae immersed, with lateral thalline margin, elongate and irregularly branched (*glaucescens*-morph); Neotropics [lectotype (Lücking *et al.* 2008): Costa Rica, *Tonduz* s.n. (G!)] . . . . . **Graphis supertecta Müll. Arg.**

15(10) Labia white-pruinose; thallus ecorticate or corticate 16
Labia non-pruinose; thallus corticate 17

16(15) Thallus ecorticate (*glaucescens*-morph); ascospores 25–35 µm long (see also Group 2: 9); pantropical . . . . . **Graphis glaucescens Fée**
A. Labia striate; ascospores 7–9-septate, 25–35 × 5–7 µm [lectotype (Wirth & Hale 1978): South America, *s.col.* (G!; isolectotype: S 2184!)] . . . . . *Graphis glaucescens* Fée
B. Labia striate; ascospores 5–9-septate, 25–35 × 6–8 µm [holotype: Paraguay, *Malme* 1526 (S-3947!; isotype: S-3948!)] . . . . . *Graphis caesioglauca* Redinger
Thallus corticate (*chloroalba*-morph); ascospores 20–25 µm long; Eastern Palaeotropics [holotype: India, *Nagarkar & Patwardhan* 86.529 (AMH, photograph seen; Makhija & Adawadkar 2005)]. . . . . **Graphis chloroalba Makhija & Adaw.**

17(15) Lirellae prominent to sessile, lacking thalline margin or very rarely with basal thalline margin 18
Lirellae erumpent, with basal to lateral thalline margin 20

18(17) Lirellae very short, usually unbranched (*granulocarpa*-morph); Neotropics [lectotype (here selected): Brazil, *Malme* 3680 (S-6502!)] . . . . **Graphis granulocarpa Redinger**
Lirellae short to elongate, sparsely to irregularly branched (*striatula*-morph) . . 19

19(18) Lirellae sessile, resembling *Glyphis substriatula*; thallus yellow-olive; ascospores 20–30 µm long; pantropical . . . . . **Graphis endoxantha Nyl.**
A. Ascospores 5–7-septate, 20–30 × 6–8 µm [holotype: New Caledonia, *Pancher* s.n. (H-Nylander 7782!)] . . . . . *Graphis endoxantha* Nyl.
B. Ascospores 5–7-septate, 20–30 × 6–10 µm [holotype: Mexico, *Pringle* 162 (H-Nylander 7776!)] . . . . . *Graphis subelegans* Nyl.
Lirellae prominent; thallus white-grey; ascospores 20–45 µm long; pantropical. . . . . **Graphis tsunodae Zahlbr.**
A. Ascospores 7–11-septate, 20–40 × 6–9 µm [holotype: Japan, *Tsunoda* 182 (W!)] . . . . . *Graphis tsunodae* Zahlbr.
B. Ascospores 5–13-septate, 20–45 × 7–9 µm [holotype: China, *s.col.* (W!; isotype: S 3950!)] . . . . . *Graphis rockii* Redinger
Notes. Lücking *et al.* (2008) treated this taxon as *G. rockii* but *G. tsunodae* is an earlier epithet. The latter was listed as synonym of *G. proserpens* by Nakanishi (1966) and Nakanishi *et al.* (2003*b*), but differs morphologically from that species in the shorter, much less branched, thicker and prominent lirellae, thus agreeing with *G. rockii*.

20(17) Lirellae with lateral thalline margin, short to elongate and sparsely to irregularly branched (*tenella*-morph); pantropical . . . . . **Graphis chlorotica A. Massal.**
A. Lirellae erumpent, with lateral thalline margin, short and sparsely branched; ascospores 9–13-septate, 30–45 × 5–8 µm [holotype: Indonesia (Java), *s.col.* (W, not seen; Hale Index Cards)] . . . . . *Graphis chlorotica* A. Massal.
B. Lirellae erumpent, with lateral thalline margin, elongate and almost radiately branched; ascospores 7–9-septate, 20–35 × 5–8 µm long [holotype: Australia, *Sayer* s.n. (G!)] . . . . . *Graphis subtenella* Müll. Arg.
C. Lirellae erumpent (to prominent), with lateral (to basal) thalline margin, short to elongate and sparsely branched; ascospores 9–13-septate, 30–50 × 7–10 µm [holotype: Philippines (TUR-Vainio 27628!)] . . . . . *Graphis duplicata* var. *australasiatica* Vain.
Lirellae lacking or with basal thalline margin, elongate and irregularly branched (*striatula*-morph). 21

21(20) Thallus verrucose; Neotropics [holotype: Jamaica, *Imshaug* 14579 (MSC-0029035!)] . . . . . **Graphis verrucoserpens Lücking**
Thallus smooth to uneven; possibly pantropical . . . **Graphis proserpens Vain.**
A. Ascospores 7–11-septate, 20–40 × 6–9 µm [holotype: Brazil, *Vainio* s. n. (TUR-Vainio 27557A!)] . . . .*Graphis proserpens* Vain. [≡ *Graphis disserpens* Vain., nom. illeg., non Nyl.]

B. Ascospores 7–9-septate, 25–45 × 6–8 µm [holotype: India, *Patwardhan & Nagarkar* 77.1806 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . .*Graphis sikkimensis* Nagarkar & Patw.

Notes. According to Nakanishi (1966) and Nakanishi *et al.* (2003*b*), *Graphis endoxantha* Asahina [nom. illeg., non Nyl.] is also a synonym of *G. proserpens*, but since their concept of the latter species is rather broad and we have not seen type material, the current status of the former could not be ascertained.

Group 14: Labia striate, excipulum apically (to peripherally) carbonized, hymenium clear, ascospores muriform

1 Norstictic and/or stictic acid (K+ yellow or K+ yellow forming red crystals) . . . 2
No substances (K−) 8

2(1) Norstictic acid (K+ yellow forming red crystals); ascospores single or 2–8 per ascus 3
Stictic acid (K+ yellow) 6

3(2) Ascospores single, medium-sized to large (60–125 µm long). 4
Ascospores 2–8 per ascus, small to medium-sized (20–60 µm long) 5

4(3) Lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Eastern Palaeotropics [isotype: India, *Watt* 83 (G!)] . . . . . **Graphis semirigida (Müll. Arg.) Lücking***
Lirellae erumpent, with apically thick complete thalline margin, elongate and irregularly branched (*consanguinea*-morph); Neotropics . . . . . **Graphis bipartita (Müll. Arg.) Lücking**

A. Ascospores 60–100 × 25–40 µm [lectotype (Wirth & Hale 1963): Paraguay, *Balansa* 1878 (G!)] . . . . . *Graphina bipartita* Müll. Arg.
B. Ascospores 60–110 × 20–30 µm [holotype: Mexico, *Pringle* 222 (H!; isotype: FH!)] . . . . . *Graphis peralbida* Nyl.

5(3) Ascospores 30–60 × 17–25 µm; lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); pantropical . . . . . **Graphis antillarum Vain.**

A. Lirellae with lateral thalline margin; ascospores 30–60 × 17–25 µm [holotype: Guadeloupe, *Duss* 540 (TUR-Vainio 27182!; isotype: FH!)] . . . . . *Graphis antillarum* Vain.
B. Lirellae with lateral thalline margin; ascospores 35–55 × 18–25 µm [holotype: Guadeloupe,*Duss* 1198 (TUR-Vainio 27178!)] . . . . . *Graphis platycarpoides* Vain.

Ascospores 20–45 × 10–17 µm; lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); pantropical . . . . . **Graphis perstriatula Nyl.**

A. Lirellae with basal thalline margin; ascospores 20–40 × 11–15 µm [lectotype (Lücking *et al.* 2008): India, *Kurz* s.n. (H-Nylander 7779!)] . . . . . *Graphis perstriatula* Nyl.
B. Lirellae with lateral thalline margin; ascospores 35–45 × 13–17 µm [holotype: Lesser Antilles, *Raunkiaer* 437 (TUR-Vainio 27243!)] . . . . . *Graphis acuminata* Vain.
C. Lirellae with basal thalline margin; ascospores 20–40 × 11–15 µm [holotype: Mariana Islands (Guam), *McGregor* 604 (TUR-Vainio 27238!)] . . . . . *Graphis gracilescens* Vain.
D. Lirellae with lateral thalline margin; ascospores 20–35 × 10–17 µm [holotype: Puerto Rico, *Fink* 659 (MICH, not seen; isotype: NY!)] . . . . . *Graphina sulcata* Fink
E. Lirellae with basal thalline margin; ascospores 20–35 × 8–13 µm [original material: Cuba, *Ekman* 5 (TUR-Vainio 27169!)] . . *Graphis polyschizans* Vain. [nom. inval. (not validly published)]

6(2) Ascospore medium-sized (45–70 × 16–22 µm); lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); Neotropics . . . . . **Graphis parilis Kremp.**

A. Ascospores 45–70 × 16–20 µm [holotype: Brazil, *Glaziou* 3394 (G!)] . . *Graphis parilis* Kremp.
B. Ascospores 50–70 × 18–20 µm [holotype: Brazil, *Glaziou* 3388 (M, not seen; Krempelhuber 1876)] . . . . . *Graphis annulata* Kremp.
C. Ascospores 45–55 × 18–22 µm [holotype: Costa Rica, *Tonduz* s.n. (G!)] . . . . . .*Graphina acromelaena* Müll. Arg.

D. Ascospores 45–65 × 16–20 µm [holotype: U.S.A. (Louisiana), *Eckfeldt* 751 (G!)] . . . . . *Graphina acrophaea* Müll. Arg.

Ascospores small (20–45 × 9–16 µm); lirellae variable 7

7(6) Lirellae erumpent, with apically thin complete thalline margin, elongate and irregularly branched (*symplecta*-morph); Eastern Palaeotropics [holotype: Philippines, *Merrill* 8576 (TUR-Vainio 27237!)] . . . . . **Graphis subducta Vain.**

Lirellae erumpent to prominent, with lateral thalline margin, short and sparsely branched (*lineola*-morph); Eastern Palaeotropics [holotype: China, *Handel-Mazzetti* 5912 (W, not seen; Zahlbruckner 1930; Hale Index Cards)] . . . . . **Graphis galactoderma (Zahlbr.) Lücking***

8(1) Ascospores medium-sized to large (50–100 µm long) 9

Ascospores small (25–45 µm long) 10

9(8) Ascospores large (70–100 × 20–30 µm), 1–2 per ascus; lirellae erumpent, with lateral thalline margin (*tenella*-morph); Neotropics (Central America) [holotype: Costa Rica, *Lücking* 17265aa (USJ!; isotype: F!)] . . **Graphis tenoriensis Lücking & Chaves**

Ascospores medium-sized (50–70 × 14–20 µm), 8 per ascus; lirellae erumpent, with apically thin complete thalline margin (*symplecta*-morph); Neotropics . . . . . **Graphis platycarpa Eschw.**

A. Ascospores 55–70 × 15–20 µm [holotype: Brazil, *Martius* s.n. (M!)] *Graphis platycarpa* Eschw.

B. Ascospores 50–70 × 14–20 µm [lectotype (Archer 2001*d*): Colombia, *Lindig* 2726 (H-Nylander 7379!)] . . . . . *Graphis sophistica* Nyl.

10(8) Ascospores 15–25 µm broad 11

Ascospores 9–15 µm broad 12

11(10) Lirellae immersed to erumpent, with apically thin complete thalline margin, short to elongate and sparsely to irregularly branched (*symplecta*-morph); ascospores 6–8 per ascus; Neotropics [holotype: Colombia, *Lindig* s.n. (H-Nylander 7404!)] . . . . . **Graphis symplecta Nyl.**

Lirellae erumpent, with lateral thalline margin, very long and radiately branched (*dichotoma*-morph); ascospores 1–2 per ascus; Neotropics [holotype: Colombia, *Lindig* 93 (H-Nylander 7415!)] . . . . . **Graphis disserpens Nyl.**

12(10) Lirellae erumpent, with apically thin complete thalline margin, elongate and irregularly branched (*symplecta*-morph); Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15667 (USJ!; isotype: F!)] . . **Graphis paraserpens Lizano & Lücking**

Lirellae erumpent, lacking or with basal thalline margin, very long and radiately branched (*sorediosa*-morph); Neotropics (Central America) [holotype: Costa Rica, *Sipman* 47989f (INB!; isotype: B!)] . . **Graphis paradisserpens Sipman & Lücking**

Group 15: Labia striate, excipulum laterally carbonized, hymenium clear, ascospores transversely septate

1 Norstictic or stictic acid or lichexanthone (K+ yellow or K+ yellow forming red crystals or UV+ yellow) 2

No substances (K−) 8

2(1) Lichexanthone (UV+ yellow, K−); lirellae prominent, lacking thalline margin, short to elongate and sparsely to irregularly branched (*striatula*-morph) 3

Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals, UV−); lirellae variable. 4

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3(2) Ascospores medium-sized (50–85 × 7–12 μm), 9–19-septate; Neotropics . . . . . **Graphis haleana R. C. Harris**

A. Ascospores 9–15-septate, 50–75 × 9–12 μm [holotype: U.S.A. (Florida), *Harris* 25248 (NY!)] . . . . . *Graphis haleana* R. C. Harris

B. Ascospores 11–19-septate, 60–85 × 7–12 μm [original material: Brazil, *Kalb* 28244 (hb. Kalb, not seen; Staiger 2002)] . . . . . *Graphis cuiabensis* Staiger [nom. inval. (not validly published)]

Ascospores small (20–40 × 7–10 μm), 5–9-septate; Neotropics . . . . . **Graphis lucifica R. C. Harris**

A. Ascospores 5–7-septate, 20–30 × 7–9 μm [holotype: USA (Florida), *Harris* 25174 (NY!)] . . . . . *Graphis lucifica* R. C. Harris,

B. Ascospores 7–9-septate, 30–40 × 8–10 μm [lectotype (Lücking *et al.* 2008): Brazil, *Malme* 3605 (S 6490!)] . . . . . *Graphis rimulosa* var. *tetraspora* Redinger

4(2) Norstictic acid (K+ yellow forming red crystals); ascospores (small to) medium-sized to large (35–150 μm long). 5

Stictic acid (K+ yellow); ascospores small (20–35 μm long) 7

5(4) Ascospores (small to) medium-sized (35–60 μm long), 7–13-septate, conspicuously thick-walled and often somewhat greyish; lirellae erumpent to prominent, lacking thalline margin, short and sparsely branched (*striatula*-morph); subcosmopolitan . . . . . **Graphis elegans (Sm.) Ach.**

A. Ascospores 9–13-septate, 35–60 × 9–13 μm [holotype: Great Britain (England), *Borrer* s.n. (BM; Staiger 2002)] . . . . . *Graphis elegans* (Sm.) Ach.

B. Ascospores 7–9-septate, 35–60 × 11–13 μm [holotype: America, *s.col.* (G, not seen; Hale Index Cards)] . . . . . *Opegrapha rhabdotis* Fée

Notes. Graphis ramificans Nyl. keys out here but we have been unable to locate type material and confirm the described characters of this taxon.

Ascospores medium-sized to large (60–150 μm long), 15–35-septate, not conspicuously thick-walled and always hyaline; lirellae erumpent to prominent, with lateral to apically thin complete thalline margin, elongate and irregularly branched . . 6

6(5) Lirellae prominent, with lateral thalline margin, elongate and irregularly branched (*celata*-morph); Eastern Palaeotropics [holotype: India, *s.col.* (BM, not seen; Adawadkar & Makhija 2007)] . . . . . **Graphis celata Stirt.**

Lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Eastern Palaeotropics [lectotype (Awasthi & Singh 1975): India, *Watt* s.n. (BM, not seen; paratype: *Watt* 76, G!)] . . . . . **Graphis verminosa Müll. Arg.**

Notes. Graphis trichospora, G. verminosa, and *G. leptospora* share the same lirella morphology, ascospore type, and chemistry, but differ in the degree of excipulum carbonization (apical *versus* lateral *versus* complete). As in other cases, and contrary to other authors, we consider these to represent distinct species, but the available material is sparse and the variation in excipulum carbonization cannot be properly assessed at this point.

7(4) Thallus sorediate; lirellae erumpent, lacking thalline margin, very long and radiately branched (*sorediosa*-morph); Eastern Palaeotropics [holotype: India, *Nagarkar* 78.364 (AMH, photograph seen; Adawadkar & Makhija 2007)] . . . . . **Graphis sorediosa Nagarkar & Patw.**

Thallus lacking soralia; lirellae erumpent, with basal thalline margin, elongate and irregularly branched (*striatula*-morph); Neotropics (SE USA) and Eastern Palaeotropics [holotype: Papua New Guinea, *Aptroot* 31685 (B!)] . . . . . **Graphis brahmanensis Aptroot***

Notes. This taxon appears to be conspecific with *Graphis* sp. 25050 in Harris (1995).

8(1) Ascospores medium-sized to large (70–190 μm long); lirellae lacking thalline margin (*striatula*-morph). 9

Ascospores small to medium-sized (15–70 μm long); lirellae variable 10

9(8) Lirellae strongly sessile (see also Group 17: 12); Eastern Palaeotropics [lectotype (Awashti & Singh 1975): India, *Watt* 6399 (G, not seen; Awasthi & Singh 1975; Hale Index Cards)] . . . . . **Graphis contortuplicata Müll. Arg.**

Lirellae erumpent; Eastern Palaeotropics [holotype: India (AMH; photograph seen; Makhija *et al.* 2006)] . . . . . **Graphis polystriata Makhija & Dube**

10(8) Lirellae erumpent to prominent, with apically thin complete thalline margin, elongate and irregularly branched (*achariі*-morph); Neotropics [holotype: Guadeloupe, *Duss* 1190 (TUR-Vainio 27848!)] . . . . . **Graphis ingarum (Vain.) Lücking***

Lirellae erumpent to prominent, lacking thalline margin or with basal to lateral thalline margin. 11

11(10) Ascospores small to medium-sized (30–65 × 7–12 μm; large ascospores exceeding 50 μm 12

Ascospores small (15–45 × 6–9 μm) 13

12(11) Lirellae prominent, lacking thalline margin or with basal thalline margin, elongate and irregularly branched (*striatula*-morph); pantropical . . . . . **Graphis striatula (Ach.) Spreng.**

A. Excipulum laterally (to almost completely) carbonized; lirellae lacking thalline margin, irregularly branched; ascospores 9–15-septate, 40–60 × 8–12 μm [holotype: Guinea, *s.col.* (H-Acharius 629!)] . . . . . *Opegrapha striatula* Ach.

B. Excipulum laterally (to almost completely) carbonized; lirellae with basal thalline margin; ascospores 11–15-septate, 50–65 × 7–9 μm [holotype: Brazil, *Malme* 640 (S-6508!)] . . . . . *Graphis bicrenatula* Redinger

C. Excipulum laterally carbonized; lirellae with basal thalline margin, stellately branched; ascospores 9–15-septate, 40–60 × 8–12 μm [lectotype (Lücking *et al.* 2008): Brazil, *Malme* 3635 (S-6488!)] . . . . . *Graphis striatula* var. *substellaris* Redinger

Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); pantropical. . . . . **Graphis leptoclada Müll. Arg.**

A. Excipulum laterally carbonized; ascospores 9–13-septate, 30–50 × 7–10 μm [lectotype (Archer 2001*e*): Indonesia (Java), *Junghuhn* s.n. (G!)] . . . . . *Graphis leptoclada* Müll. Arg.

B. Excipulum laterally (to completely) carbonized; ascospores 9–13-septate, 40–65 × 9–12 μm [lectotype (Wirth & Hale 1978): Costa Rica, *Pittier* 5291 (G!)] . . *Graphis rigidula* Müll. Arg.

C. Excipulum laterally carbonized; ascospores 7–13-septate, 30–50 × 7–10 μm [holotype: Puerto Rico, *Fink* 1873 (MICH, not seen; isotype: NY!)] . . . *Graphis rimulosa* subsp. *lignicola* Fink

13(11) Lirellae erumpent to prominent, lacking thalline margin or with basal thalline margin, elongate and irregularly branched (*striatula*-morph); pantropical. . . . . **Graphis duplicata Ach.**

A. Excipulum laterally carbonized; lirellae lacking thalline margin; ascospores 7–11-septate, 25–45 × 6–8 μm [lectotype (Staiger 2002): South America, *s.col.* (H-Acharius 586!)] . . . . . *Graphis duplicata* Ach.

B. Excipulum laterally (to almost completely) carbonized; lirellae with basal thalline margin; ascospores 7–13-septate, 25–45 × 7–9 μm [syntypes: Indonesia (Java), *s.col.* (G!)] . . . . . *Graphis schizograpta* Müll. Arg.

C. Excipulum laterally carbonized; lirellae lacking thalline margin; ascospores 7–9-septate, 25–35 × 6–8 μm [holotype: China, *Handel-Mazzetti* 10213 (W!)] . . *Graphis lopingensis* Zahlbr.

D. Excipulum laterally carbonized; lirellae lacking thalline margin; ascospores 9–11-septate, 25–30 × 7–8 μm [holotype: China, *Handel-Mazzetti* 9103 (W!; isotype: S 2173!)] . . . . . *Graphis lussuensis* Zahlbr.

Lirellae erumpent, with lateral thalline margin, short and sparsely branched (*tenella*-morph); pantropical . . . . . **Graphis tenella Ach.**

A. Ascospores 5–9-septate, 20–30 × 6–8 μm [holotype: Guinea, *s.col.* (H-Acharius 585!)]. . . . . *Graphis tenella* Ach.

B. Ascospores 5–7-septate, 20–30 × 6–8 μm [holotype: Jamaica, *Hart* 101 (G!)] . . . . . *Phaeographis sulcata* Müll. Arg.

C. Ascospores 5–7-septate, 15–30 × 7–8 μm [holotype: India, *Patwardhan & Nagarkar* 77.1495 (AMH, photograph seen; Awasthi 1991; Nagarkar & Patwardhan 1982)] . . . . . *Graphis subglauconigra* Nagarkar & Patw.

Group 16: Labia striate, excipulum laterally carbonized, hymenium clear, ascospores muriform

1 Norstictic and stictic acid (K+ yellow forming red crystals); lirellae immersed, with lateral thalline margin, very long and radiately branched (*dichotoma*-morph); Neotropics [holotype: Brazil, *Vainio s.n.* (TUR-Vainio 27202!; G!)] . . . . . **Graphis neoelongata Lücking***
[≡ *Graphis elongata* Vain., nom. illeg., non Zenker]
No substances (K−); lirellae variable 2

2(1) Ascospores 40–75 × 20–30 µm, 2 per ascus; lirellae erumpent (to prominent), with basal thalline margin, short and sparsely branched (*striatula*-morph); Eastern Palaeotropics [holotype: Malaysia (Borneo: Sabah), *Hale* 29240 (US!)] . . . . . **Graphis subintermedians Hale ex Lücking***
Ascospores 20–60 × 8–16 µm, (2–)4–8 per ascus; lirellae variable 3

3(2) Lirellae erumpent, with lateral thallin margin, very long and radiately branched (*dichotoma*-morph); ascospores 20–35 µm long; Neotropics . . . . . **Graphis dichotoma (Müll. Arg.) Lücking**
A. Ascospores 8/ascus, 20–25 × 7–10 µm [holotype: Brazil, *Puiggari* 508 (G!)] . . . . . *Graphina dichotoma* Müll. Arg.
B. Ascospores (2–)4–8 per ascus, 25–35 × 10–13 µm [holotype: Puerto Rico, *Fink* 2049 (MICH, not seen; Wirth & Hale 1978)] . . . . . *Graphis elongatoradians* Fink
Lirellae erumpent, with lateral to apically thin complete thalline margin, short and sparsely branched (*tenella*- or *symplecta*-morph); ascospores 25–60 µm long . . 4

4(3) Ascospores 35–60 µm long; lirellae with lateral thalline margin (*tenella*-morph); Neotropics (Central America) [holotype: Costa Rica, *Chaves* 466 (INB!; isotype: CR!)] . . . . . **Graphis pseudoserpens Chaves, Lücking & Umaña**
Ascospores 25–40 µm long; lirellae with apically thin complete thalline margin (*symplecta*-morph); Neotropics . . . **Graphis puiggarii (Müll. Arg.) Lücking**
A. Excipulum laterally carbonized; ascospores 25–35 × 8–12 µm [holotype: Brazil, *Puiggari* 506 (G!)] . . . . . *Graphina puiggarii* Müll. Arg.
B. Excipulum laterally (to completely) carbonized; ascospores 30–40 × 12–16 µm [holotype: Paraguay, *Balansa* s.n. (G!)] . . . . . *Graphina endoschiza* Müll. Arg.

Group 17: Labia striate, excipulum completely carbonized, hymenium clear, ascospores transversely septate

1 Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals). 2
No substances (K−) 9

2(1) Norstictic acid (K+ yellow forming red crystals) 3
Stictic acid (K+ yellow) 7

3(2) Ascospores small (20–40 µm long) 4
Ascospores medium-sized to large (50–120 µm long) 5

4(3) Lirellae erumpent, with lateral thalline margin, short and sparsely branched (*tenella*-morph); Eastern Palaeotropics [holotype: Indonesia, *Schiffner* 3138 (W!; isotype: FH!)] . . . . . **Graphis schiffneri Zahlbr.**
Notes. The material identified with that name from Costa Rica (Lücking *et al.* 2008) does not belong to that species but represents an aberrant form of *Graphis caesiella* in which the labia pruina appears in thin lines making the labia appear striate.

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Lirellae prominent, with basal thalline margin, short and sparsely branched (*striatula*-morph); pantropical [holotype: India, *Watt* s.n. (G!)] . . . . . **Graphis paralleloides Cáceres & Lücking**⋆
[≡ *Graphis rimulosa* var. *parallela* Müll. Arg., non *Graphis parallela* Müll. Arg.]

5(3) Lirellae prominent, with thick lateral thalline margin, elongate and irregularly branched (*marginata*-morph); ascospores medium-sized (50–60 µm long); Neotropics [holotype: Colombia, *Lindig* 858 (H-Nylander 7604!)] . . **Graphis subtracta Nyl.**
Lirellae erumpent to prominent, with apically thin complete thalline margin or thin thalline margin that flakes off to expose black labia; ascospores large (80–120 µm long) 6

6(5) Lirellae prominent, with thin thalline margin that often flakes off to expose black labia, short and sparsely branched, with very distinct and coarse striation (*lumbricina*-morph); ascospores 15–21 µm broad (see also Group 4: 4); Neotropics and Hawaii [lectotype (Wirth & Hale 1978): Guadeloupe, *Duss* 1036 (TUR-Vainio 27524!; isolectotype: FH!)] . . . . . **Graphis lumbricina Vain.**
Lirellae erumpent to prominent, with persistent, apically thin thalline margin, elongate and irregularly branched, with fine striation; ascospores 6–10 µm broad; Eastern Palaeotropics [holotype: Thailand, *Hosseus* s.n. (TUR-Vainio 27807!)] . . . . . **Graphis leptospora Vain.**

Notes. Graphis trichospora, G. verminosa, and *G. leptospora* share the same lirella morphology, ascospore type, and chemistry, but differ in the degree of excipulum carbonization (apical *versus* lateral *versus* complete). As in other cases, and contrary to other authors, we consider these to represent distinct species, but the available material is sparse and the variation in excipulum carbonization cannot be properly assessed at this point.

7(2) Ascospores large (75–90 µm long); lirellae erumpent, with lateral thalline margin, elongate to very long and irregularly branched, labia thinly white-pruinose (*albotecta*-morph); Eastern Palaeotropics [holotype: India, *Sethy & Patwardhan* 85.2715 (AMH, photograph seen; Makhija & Adawadkar 2005)] . . . . . **Graphis longissima Makhija & Adaw.**
Ascospores small (25–45 µm long); lirellae variable 8

8(7) Lirellae erumpent, with apically thin complete thalline margin, elongate and irregularly branched (*symplecta*-morph); ascospores 5–7-septate, 25–35 µm long; Neotropics (Antilles) and Eastern Palaeotropics [holotype: Vietnam, *Balansa* s.n. (G!)] . . . . . **Graphis fumosa Müll. Arg.**
Lirellae with basal thalline margin, elongate and irregularly branched; ascospores 9–13-septate, 35–45 µm long; Eastern Palaeotropics [holotype: India, *Patwardhan* 78.109 (AMH, photograph seen; Adawadkar & Makhija 2006)] . . . . . **Graphis nilgiriensis Adaw. & Makhija**

9(1) Ascospores medium-sized to large (50–160 µm long) 10
Ascospores (very) small (15–50 µm long) 17

10(9) Ascospores large (most mature ascospores exceeding 70 × 12 µm) 11
Ascospores medium-sized (mature ascospores not exceeding 70 × 12 µm) . . . 15

11(10) Lirellae prominent to sessile, lacking or with basal thalline margin (*striatula*-morph) 12
Lirellae immersed to prominent, with lateral to complete thalline margin 13

12(11) Lirellae short and sparsely branched; ascospores 1–2 per ascus; Neotropics [holotype: Brazil, *Glaziou* s.n.; G, not seen; Awasthi 1991)] . . . . . **Graphis granulata Fée**

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Lirellae elongate and irregularly branched; ascospores 6–8 per ascus (see also Group 15:9); Eastern Palaeotropics [lectotype (Awashti & Singh 1975): India, *Watt* 6399 (G, not seen; Awasthi & Singh 1975; Hale Index Cards)] . . . . **Graphis contortuplicata Müll. Arg.**

13(11) Ascospores 120–160 × 17–25 µm; lirellae prominent, short and sparsely branched (*acharii*-morph); pantropical [holotype: unknown locality (UPS, not seen; Müller Argoviensis 1887)] . . . . . **Graphis vestita Fr.** [non Fée]

Ascospores 70–120 × 10–17 µm; lirellae immersed to prominent 14

14(13) Lirellae prominent (*acharii*-morph); pantropical . . . **Graphis angustata Eschw.**

A. Ascospores 11–15-septate, 70–100 × 12–18 µm [holotype: Brazil, *Martius* s.n. (M, not seen; Hale Index Cards)] . . . . . *Graphis angustata* Eschw.

B. Ascospores 15–21-septate, 90–120 × 12–15 µm [lectotype (Wirth & Hale 1978): Brazil, *Glaziou* 5106 (M, not seen; Staiger 2002)] . . . . . *Graphis flexibilis* Kremp.

Ascospores 15–21-septate, 70–100 × 11–13 µm [lectotype (Lücking *et al.* 2008): Philippines, *Elmer* 14443 (TUR-Vainio 27866!)] . . . . . *Graphis subangustata* Vain.

Notes. Graphis subcurva Zenker might represent an earlier name for this species but we have been unable to locate authentic material.

Lirellae immersed to erumpent (*symplecta*-morph); pantropical (also saxicolous) . . . . . **Graphis calcea (Fée) A. Massal.**

A. Lirellae erumpent; ascospores 15–25-septate, 80–190 × 12–16 µm [holotype: Antilles or South America, *s.col.* (G, not seen; Wirth & Hale 1978)] . . . . . *Opegrapha calcea* Fée

B. Lirellae erumpent; ascospores 15–19-septate, 80–110 × 14–17 µm [holotype: New Caledonia, *Saves* s.n. (G!)] . . . . . *Graphis noumeana* Müll. Arg.

C. Lirellae immersed; ascospores 15–19-septate, 70–100 × 14–17 µm [holotype: Brazil, *Ule* s.n. (G!)] . . . . . *Graphis virens* Müll. Arg.

D. Lirellae erumpent; ascospores 11–19-septate, 70–120 × 10–15 µm [holotype: Brazil, *Ule* 273 (G!; isotype: MICH!)] . . . . . *Graphis illota* Müll. Arg.

E. Lirellae erumpent; ascospores 9–13-septate, 70–100 × 13–16 µm [holotype: Paraguay, *Malme* 1438 (S 6482!)] . . . . . *Graphis virens* var. *saxicola* Redinger

F. Lirellae immersed; ascospores 15–19-septate, 70–90 × 11–14 µm [lectotype (here selected): Brazil, *Malme* 1293 (S-6484!)] . . . . . *Graphis tenuescens* var. *subimmersa* Redinger

15(10) Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); pantropical. . . . . **Graphis longula Kremp.**

A. Lirellae erumpent, with lateral thalline margin; ascospores 11–17-septate, 50–70 × 10–13 µm [lectotype (Wirth & Hale 1978): Brazil, *Glaziou* 5497 (M!)] . . . . . *Graphis longula* Kremp.

B. Lirellae erumpent (to prominent), with (basal to) lateral thalline margin; ascospores 9–17-septate, 60–70 × 9–11 µm [holotype: Brazil, *Glaziou* 5498 (G!)] . . . . . *Graphis flavicans* Müll. Arg.

C. Lirellae erumpent, with basal thalline margin; ascospores 11–15-septate, 40–65 × 7–10 µm [lectotype (here selected): Philippines, *Copeland* 1362 (TUR-Vainio 27862!)] . . . . . *Graphis supernata* Vain.

Lirellae erumpent to prominent, with apically thin complete thalline margin (upper part of labia dark grey) 16

16(15) Lirellae short to elongate, stellately branched (*asterizans*-morph); thallus verrucose; pantropical [holotype: China (Hong Kong), *s.col.* (H-Nylander 7781!)] . . . . . **Graphis asterizans Nyl.**

Lirellae short to elongate, sparsely to irregularly branched (*acharii*-morph); thallus smooth to uneven; Palaeotropics . . . . . **Graphis glauconigra Vain.**

A. Ascospores 9–13-septate, 40–80 × 8–12 µm [lectotype (here selected, based on annotation labels by Nakanishi in 1973 and Awasthi & Mathur in 1989): Philippines, *Merrill* 6791 (TUR-Vainio 27884!)] . . . . . *Graphis glauconigra* Vain.

B. Ascospores 11–13-septate, 55–65 × 10–12 µm [holotype: Puerto Rico, *Fink* 1737 (MICH, not seen; isotype: NY!)] . . . . . *Graphis tumidulella* Fink

C. Ascospores 11–13-septate, 60–70 × 9–11 µm [holotype: China, *Chung* 393a (W!; isotype: FH!)] . . . . . *Graphis chungii* Zahlbr.

D. Ascospores 11–15-septate, 65–75 × 9–11 µm [holotype: China, *Chung* 388 (W!; isotype: FH!)] . . . . . *Graphis chungii* var. *oligospora* Zahlbr.

17(9) Lirellae broad (0·5–1), erumpent, with basal to lateral thalline margin, short and sparsely branched (*tenella*-morph); Neotropics [holotype: Brazil, *Aptroot* 41306 (SP!; isotype: ABL!)] . . . . . **Graphis funilina Aptroot⋆**

Lirellae narrow (0.2–0.4 mm), erumpent to sessile, lacking or with basal to lateral thalline margin. 18

18(17) Lirellae erumpent to prominent, with lateral thalline margin, short and sparsely branched (*tenella*-morph); ascospores 15–30 µm long; pantropical . . . . . **Graphis aurita Eschw.**

A. Lirellae prominent, with lateral thalline margin; ascospores 7-septate, 15–25 × 6–8 µm [holotype: Brazil, *s.col.* (M, not seen; Hale Index Cards)] . . . . . *Graphis aurita* Eschw.

B. Lirellae erumpent, with lateral thalline margin; ascospores 7–11-septate, 25–30 × 5–7 µm [holotype: India, *s.col.* (BM, not seen; Awasthi 1991)] . . . . . *Graphis persulcata* Stirt.

C. Lirellae erumpent, with lateral thalline margin; ascospores 7–13-septate, 20–45 × 7–8 µm [holotype: Puerto Rico, *Fink* 1613 (MICH, not seen; Fink 1927)] . . . . *Graphis immersa* Fink

Notes. Unfortunately no type material of the above names was available for study and the concept of this taxon must be considered provisional at this point.

Lirellae erumpent to sessile, lacking thalline margin or with basal thalline margin; ascospores 20–50 µm long 19

19(18) Lirellae sessile, very long and radiately branched (*slendrae*-morph); Eastern Palaeotropics [holotype: Malaysia (Borneo: Sabah), *Hale* 28009 (US!)] . . . . . **Graphis slendrae Hale ex Lücking⋆**

Lirellae erumpent to prominent, short and sparsely branched (*striatula*-morph) 20

20(19) Ascospores 30–50 × 7–13 µm; pantropical . . **Graphis rimulosa (Mont.) Trevis.**

A. Lirellae erumpent, lacking thalline margin; ascospores 7–11-septate, 30–50 × 7–13 µm [lectotype (Wirth & Hale 1978): Guyana, *Leprieur* 200 (PC, not seen; Hale Index Cards)] . . . . . *Opegrapha rimulosa* Mont.

B. Lirellae prominent, with basal thalline margin; ascospores 7–11-septate, 35–50 × 7–10 µm [holotype: Australia, *Shirley* 1821 (G!)] . . . . . *Graphis rimulosa* var. *brachycarpa* Müll. Arg.

Notes. Graphis rimulosa var. *brachycarpa* was listed as synonym of *G. striatula* by Archer (2006), but the type has a completely carbonized excipulum and slightly smaller ascospores and thus agrees with *G. rimulosa*.

Ascospores 20–40 × 5–9 µm; pantropical . . . . . **Graphis dupaxana Vain.**

A. Lirellae prominent, lacking thalline margin; ascospores 7–9-septate, 25–40 × 7–9 µm [lectotype (here selected, based on annotation label by Nakanishi in 1973): Philippines, *McGregor* 14313 (TUR-Vainio 27869!)] . . . . . *Graphis dupaxana* Vain.

B. Lirellae prominent, with basal thalline margin; ascospores 5–11-septate, 20–35 × 5–8 µm [holotype: Indonesia (Borneo), *Moulton* s.n. (TUR-Vainio 27859!)] . . . . *Graphis moultonii* Vain.

C. Lirellae prominent, with basal thalline margin; ascospores 3–7-septate, 15–20 × 7–8 µm [holotype: Brazil, *Puiggari* 136 (G, not seen; Müller Argoviensis 1880; Redinger 1935)] . . . . . *Graphis leioplaca* Müll. Arg.

Group 18: Labia striate, excipulum completely carbonized, hymenium clear, ascospores muriform

1 Ascospores terminally muriform, with longitudinal septa in terminal segments only 2

Ascospores regularly muriform or submuriform with at least a few longitudinal septa in middle segments 4

2(1) No substances (K−); ascospores large (80–150 µm long); lirellae prominent, with apically thin complete margin; elongate and irregularly branched (*acharii*-morph); Neotropics and Eastern Palaeotropics . . **Graphis vestitoides (Fink) Staiger**

A. Ascospores 80–140 × 12–16 µm [lectotype (Wirth & Hale 1978): Puerto Rico, *Fink* 1986 (MICH, not seen; Staiger 2002)] . . . . . *Graphina vestitoides* Fink

B. Ascospores 90–140 × 11–16 µm [lectotype (here selected): Philippines, *Elmer* 14443 (TUR-Vainio 27224!; isolectotype: FH!)] . . . . . *Graphis fruticicola* Vain.
C. Ascospores 80–150 × 12–17 µm [holotype: Brazil, *Malme* 3531 (S!)] . . . . . *Phaeographis cerviculata* Redinger

Norstictic acid (K+ yellow forming red crystals); ascospores and lirellae variable . 3

3(2) Ascospores medium-sized (50–80 µm long); lirellae prominent, with lateral thalline margin, short and stellately branched (*stellata*-morph); Neotropics and Eastern Palaeotropics [holotype: Brazil, *s.col.* (G, not seen; Wirth & Hale 1978; Hale Index Cards)] . . . . . **Graphis congesta (Fée) Müll. Arg.**

Notes. This taxon is usually understood as having transversely septate ascospores (Wirth & Hale 1978), which would make it a synonym of *G. marginata*, but the ascospores contain (easily overlooked) terminal longitudinal septa.

Ascospores large (80–150 µm long); lirellae prominent, with apically thin complete margin; elongate and irregularly branched (*acharii*-morph); Neotropics and Eastern Palaeotropics [holotype: Thailand, *Sutjaritturakan* 12736 (RAMK!)] . . . . . **Graphis norvestitoides Sutjaritturakan**

Notes. This taxon was erroneously identified with *Graphis aquilonia* by Lücking *et al*. (2008) but the latter differs in the entire labia and lirellae with apically thick complete thalline margin.

4(1) Norstictic or stictic acid (K+ yellow or K+ yellow forming red crystals). 5

Notes. If protocetraric acid (P+ red) and ascospores I− and very small (15–25 µm long), cf. *Graphis pauaiensis* Vain which probably belongs in *Carbacanthographis*.

No substances or hypostictic acid (K−) 7

5(4) Ascospores single, medium-sized to large (60–140 × 20–35 µm); lirellae erumpent, with apically thin complete margin, elongate and irregularly branched (*symplecta*-morph); norstictic acid; Neotropics [holotype: Colombia, *Lindig* s.n. (H-Nylander 7530!)] . . . . . **Graphis componens Nyl.**

Ascospores 4–8 per ascus, small (15–50 × 7–12 µm); lirellae and chemistry variable . 6

6(5) Ascospores 4 per ascus, 30–50 µm long; norstictic acid; lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Neotropics [holotype: Venezuela, *Neuwirth* 8517 (W!)] . . . . . **Graphis breussii Neuwirth & Lücking**

Ascospores 8 per ascus, 15–25 µm long; stictic acid; lirellae erumpent to prominent, lacking or with basal thalline margin, elongate and irregularly branched (*striatula*-morph); Eastern Palaeotropics [holotype: China, *Handel-Mazzetti* 11507 (W!)] . . . . . **Graphis hunanensis (Zahlbr.) M. Nakan. & Kashiw.**

7(4) Ascospores (medium-sized to) large [(70–)80–170 × 15–45 µm, most mature ascospores exceeding 80 µm] 8

Ascospores small to medium-sized (20–80 × 10–25 µm). 13

8(7) Ascospores 2–6 per ascus; lirellae prominent to sessile, with apically thin complete thalline margin, short to elongate and sparsely to irregularly branched (*acharii*-morph); Neotropics and Eastern Palaeotropics (also saxicolous) . . . . . **Graphis acharii Fée**

A. Thallus smooth to uneven; lirellae prominent, elongate and irregularly branched; ascospores 80–170 × 15–30 µm [holotype: South America, *s.col.* (G; not seen; isotype: L!)] . . . . . *Graphis acharii* Fée
B. Thallus smooth to uneven; lirellae prominent, short and sparsely branched; ascospores 90–150 × 18–30 µm [holotype: Brazil, *Glaziou* 5486 (G!)] . . . . . *Graphis curta* Fée
C. Thallus verrucose; lirellae prominent, elongate and irregularly branched; ascospores 100–120 × 20–30 µm [holotype: Brazil, *Glaziou* 11777 (G!)]. . . *Graphina tuberculifera* Müll. Arg.
D. Thallus smooth to uneven; lirellae sessile, short and sparsely branched; ascospores 100–150 × 20–30 µm [holotype: Brazil, *Glaziou* 16671 (G!)] . . . . . *Graphina pachypleura* Müll. Arg.

Ascospores single or 1–2 per ascus; lirellae variable 9

9(8) Thallus and lirellae verrucose; hypostictic acid 10
Thallus and lirellae smooth to uneven; no substances 11

10(9) Lirellae sessile, with distinctly verrucose, apically thin complete thalline margin, very short and unbranched (*granulosa*-morph); Neotropics [holotype: Jamaica, *Hart* s.n. (G!)] . . . . . **Graphis granulosa (Müll. Arg.) Lücking**
Lirellae immersed to erumpent, with slightly verrucose, apically thick complete thalline margin, elongate and irregularly branched (*consanguinea*-morph); Neotropics and Eastern Palaeotropics . . . . . **Graphis dealbata Nyl.**
A. Ascospores 80–110 × 20–35 µm [holotype: Brazil, *Glaziou* 1899 (H-Nylander 7531!)] . . . . . *Graphis dealbata* Nyl.
B. Ascospores 80–100 × 20–30 µm µm [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27177!)] . . . . . *Graphis albostriata* Vain.

11(9) Lirellae erumpent, with lateral thalline margin (*tenella*-morph); Neotropics and Eastern Palaeotropics (Thailand) . . **Graphis myrtacea (Müll. Arg.) Lücking**
A. Ascospores single, 100–150 × 25–40 µm [holotype: Brazil, *Ule* 127 (G!)] . . . . . *Graphina myrtacea* Müll. Arg.
B. Ascospores 1–2 per ascus, 75–115 × 30–45 µm [lectotype (Staiger 2002): Brazil, *Malme* 2311 (S!)] . . . . . *Graphina crystallifera* Redinger
Lirellae immersed to prominent, with apically thin to thick complete thalline margin (*acharii*- or *consanguinea*-morph) 12

12(11) Lirellae prominent, with apically thin complete thalline margin (*acharii*-morph); Neotropics . . . . . **Graphis macella Kremp.**
A. Ascospores single, 70–170 × 20–40 µm [lectotype (Wirth & Hale 1978): Brazil, *Glaziou* 6289b (M!; Staiger 2002)] . . . . . *Graphis macella* Kremp.
B. Ascospores single, 80–150 × 20–30 µm [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27186!)] . . . . . *Graphis subvestita* Vain.
Ascospores 1–2 per ascus, 85–135 × 17–25 µm [holotype: Brazil, *Mosén* 2143 (S-2203!)] . . . . . *Graphina carbocarpa* Redinger
Lirellae immersed to erumpent, with apically thick complete thalline margin (*consanguinea*-morph); Neotropics . . . . . **Graphis consanguinea (Müll. Arg.) Lücking**
A. Lirellae immersed; ascospores single, 110–125 × 30–35 µm [holotype: Brazil, *Glaziou* s.n. (G!)] . . . . . *Graphina consanguinea* Müll. Arg.
B. Lirellae erumpent; ascospores single, 70–170 × 25–40 µm [holotype: Brazil, *Vainio* s.n. (TUR-Vainio 27092!; isotype: M)] . . . . . *Graphina includens* Vain.
C. Lirellae erumpent; ascospores single, 140–170 × 30–40 µm [lectotype (Staiger 2002): Brazil, *Vainio* s.n. (M; Staiger 2002; isolectotype: TUR-Vainio 27244!)] . . . . . *Graphina pseudosophistica* Vain.
D. Lirellae erumpent; ascospores single, 90–120 × 25–35 µm [holotype: Brazil, *Glaziou* 5017b (W!)] . . . . . *Graphina nylanderiana* Zahlbr. [non Patw. & C. R. Kulk.]
E. Lirellae erumpent; ascospores single, 90–150 × 25–35 µm [holotype: Brazil, *Malme* 1227B (S, not seen; Redinger 1934)] . . . . . *Graphina heteroplacoides* Redinger

13(7) Lirellae prominent, lacking thalline margin (*striatula*-morph); thallus yellow-green to olive-yellow; Central America [holotype: Costa Rica, *Lücking* 16661 (USJ!; isotype: F!)] . . . . . **Graphis fournierii Lizano & Lücking**
Notes. If lirellae with distinct brown pruina along slit, cf. *Glyphis substriatula* (Nyl.) Staiger*.
Lirellae erumpent to prominent, with lateral to complete thalline margin; thallus white-grey to rarely olive-grey 14

14(13) Labia white-pruinose; lirellae erumpent, with lateral thalline margin, short and sparsely branched (*albotecta*-morph); mature ascospores not exceeding 45 µm; South America . . . . . **Graphis albotecta (Redinger) Staiger**
A. Ascospores 30–45 × 10–19 µm [holotype: Brazil, *Malme* 3532 (S 5528!)] . . . . . *Graphina albotecta* Redinger

B. Ascospores 30–45 × 10–15 µm [holotype: Brazil, *Malme* 1089 (S 2190!)] . . . . . *Graphina rimulosa* Redinger

Labia non-pruinose; lirellae erumpent to prominent, with lateral to complete thalline margin; mature ascospores exceeding 45 µm 15

15(14) Mature ascospores exceeding 65 µm 16
Mature ascospores 30–65 µm long 17

16(15) Lirellae immersed, with apically thick complete thalline margin, elongate and irregularly branched (*consanguinea*-morph); ascospores 20–30 µm broad; Eastern Palaeotropics (China) [lectotype (here selected, based on annotation label by Nakanishi in 1973): China, *Chung* 602b (W!)] . . . . . **Graphis plumbea (Zahlbr.) Lücking***
Labia prominent, with apically thin complete thalline margin, short and sparsely branched (*acharii*-morph); ascospores 12–15 µm broad; Eastern Palaeotropics [holotype: Taiwan, *Asahina* 345 (W!; isotype: US!)] . . . . . **Graphis oxyspora (Zahlbr.) Lücking***

17(15) Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched (*tenella*-morph); ascospores 10–15 µm broad; Neotropics and African Palaeotropics [lectotype (Wirth & Hale 1978): Brazil, *Malme* 998 (S 6508!)] . . . . . **Graphis plurispora (Redgr.) Lücking & Chaves**
Lirellae erumpent to prominent, with apically thin complete thalline margin; ascospores 15–23 µm broad 18

18(17) Lirellae very short and unbranched (*multisulcata*-morph); Neotropics [holotype: Brazil, *Puiggari* 74 (G!)] . . . . **Graphis multisulcata (Müll. Arg.) Lücking & Chaves**
Lirellae elongate to very long and irregularly to radiately branched (*subradiata*-morph); Neotropics [holotype: Colombia, *Lindig* 2725 (H-Nylander 7434!)] . . . . . **Graphis subradiata (Nyl.) Lücking***

Notes. Graphis analoga var. *subradiata* Nyl. was considered a synonym of *G. multisulcata* by Lücking *et al.* (2008), but the two differ markedly in their lirella morphology. The material referred to as *G. multisulcata* by Lücking *et al.* (2008) belongs to *G. subradiata*.

Group 19: Labia striate, excipulum completely carbonized, hymenium inspersed, ascospores transversely septate

1 Ascospores small (25–35 × 5–7 µm), 9–13-septate; stictic acid (K+ yellow); lirellae erumpent, lacking thalline margin (*striatula*-morph); Neotropics (Central America) [holotype: Costa Rica, *Aptroot* 60569 (INB!)] . . . **Graphis syzygii Aptroot***
Notes. This new species was not recognized in the recent treatment by Lücking *et al.* (2008).
Ascospores large to very large (75–200 × 15–30 µm); norstictic acid (K+ yellow forming red crystals) or no substances (K−) 2

2(1) No substances (K−); ascospores 100–200 × 18–30 µm; lirellae prominent, with apically thin complete thalline margin, short and sparsely branched (*acharii*-morph); Neotropics and Eastern Paleotropics [holotype: South America, *s.col.* (G!)] . . . . . **Graphis cinerea Fée**
Norstictic acid (K+ yellow forming red crystals); ascospores 75–100 × 15–22 µm; lirellae variable 3

3(2) Lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Eastern Palaeotropics [holotype: Indonesia (Java), *Groenhart* 5190 (L!)] . . . . . **Graphis leucaenae Aptroot***

Lirellae erumpent, lacking thalline margin, short and sparsely branched (*striatula*-morph); Eastern Palaeotropics [holotype: Papua New Guinea, *Aptroot* 37028 (B!)] . . . . . **Graphis inspersolongula Aptroot***

Group 20: Labia striate, excipulum completely carbonized, hymenium inspersed, ascospores muriform

1 Ascospores terminally muriform; lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph); Neotropics (Central America) and Eastern Palaeotropics (Thailand) [holotype: Costa Rica, *Chaves* 423 (INB!)] . . . . . **Graphis subflexibilis Lücking & Chaves**

Ascospores regularly muriform; lirellae variable 2

2(1) Norstictic acid (K+ yellow forming red crystals); ascospores small (20–45 × 9–12 µm); lirellae erumpent, with lateral thalline margin, short and sparsely branched (*tenella*-morph); Neotropics [holotype: Guadeloupe, *Duss* 1590 (TUR-Vainio 27248!)] . . . . . **Graphis pseudoanaloga Vain.**

No substances (K−); ascospores medium-sized to large (50–180 × 9–35 µm); lirellae prominent, with apically thin complete thalline margin, elongate and irregularly branched (*acharii*-morph) 3

3(2) Ascospores medium-sized (50–70 × 9–12 µm); Neotropics (Central America) [holotype: Costa Rica, *Lücking* 15235a (F!)] . . **Graphis pseudocinerea Lücking & Umaña**

Ascospores large (80–180 × 10–35 µm). 4

4(3) Ascospores very long and narrow (120–180 × 10–15 µm), more than 10 times as long as broad, with only some segments having longitudinal septa (submuriform); Neotropics (Central America) [holotype: Costa Rica, Sipman 48019a (INB!)] . . . . . **Graphis altamirensis Sipman & Lücking**

Ascospores shorter and broader (80–140 × 15–35 µm), less than 10 times as long as broad, with all segments having longitudinal septa (muriform) 5

5(4) Ascospores 1–4 per ascus, 25–35 µm broad, about 3–4 times as long as broad (see also Group 11: 7); pantropical . . . . . **Graphis phaeospora Vain.**

Labia striate [original material: not designated (Staiger 2002)] . . . . . *Graphis subcinerea* Staiger [nom. inval. (not validly published)]

Ascospores 4–8 per ascus, 15–25 µm broad, about 5–6 times as long as broad (see also Group 11: 7); Neotropics [holotype: Costa Rica, *Lücking* 15269d (INB!)] . . . . . **Graphis argentata Lücking & Umaña**

Labia striate [original material: not designated (Lücking *et al.* 2008)] . . . . . *Graphis cinereoides* Lücking & Chaves [nom. inval. (not validly published)]

Nomenclatural novelties

Carbacanthographis cleitops (Fée) Lücking comb. nov.

Graphis cleitops Fée, *Suppl. Essai Crypt. Écorc.*: 32 (1837); *Graphina cleitops* (Fée) Müll. Arg., *Mém. Soc. Phys. Hist. Nat. Genève* **29(8):** 41 (1887); type: Unknown locality, *s.col.* (G!— holotype).

Carbacanthographis coccospora (Aptroot) Aptroot & Lücking comb. nov.

Graphis coccospora Aptroot, *Fungal Div.* **9:** 19 (2002); type: Brazil, *Aptroot* 41071 (ABL!—holotype).

Carbacanthographis induta (Müll. Arg.) Lücking comb. nov.

Graphis induta Müll. Arg., *Hedwigia* **30:** 185 (1891); type:): Vietnam, *Balansa* s.n. (G! —holotype).

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Notes. The type material has *Carbacanthographis*-like lirellae and I− ascospores, which justifies recombination in *Carbacanthographis*. The only species in that genus with similar ascospores is *C. candidata* (Nyl.) Staiger & Kalb, which produces protocetraric acid. Norstictic acid as major substance was previously unknown in *Carbacanthographis* (Staiger 2002; Archer 2006).

Carbacanthographis triphoroides (M. Wirth & Hale) Lücking comb. nov.

Graphina triphoroides M. Wirth & Hale, *Smithson. Contr. Bot.* **40:** 44 (1978); *Graphis triphoroides* Nyl., *Flora* **69:** 103 (1886); nom. inval.; type: Cuba, Wright 15 (H-Nylander 7520!—holotype; US!—isotype).

Notes. This taxon was indicated as a synonym of *Graphina crassa* (Müll. Arg.) [≡ *Carbacanthographis crassa* (Müll. Arg.) Staiger & Kalb] by Nakanishi (annotation label in 1973). However, the two species differ markedly: *C. crassa* has a completely carbonized excipulum, single-spored asci, and the ascospores are I− (I+ weakly violet in *C. triphoroides*).

Glyphis atrofusca (Müll. Arg) Lücking

In Archer, *Flora of Australia* **57:** 651 (2009); *Graphina atrofusca* Müll. Arg., *Flora* **70:** 74 (1887); *Graphis atrofusca* (Müll. Arg.) Stizenb., *Ber. Tät. St. Gallisch. Naturw. Gesellsch.* **1889–1890:** 186 (1891); type: South Africa, *Wilms* 70 (G!— lectotype, here selected).

Graphina polycarpa Müll. Arg., *Flora* **70:** 63 (1887); *Graphis polycarpa* (Müll. Arg.) Stizenb., *Ber. Tät. St. Gallisch. Naturw. Gesellsch.* **1889–1890:** 184 (1891); type: South Africa, *Wilms* 48 (G!—(holotype).

Graphina montoensis A. W. Archer, *Mycotaxon* **77:** 168 (2001); *Glyphis montoensis* (A. W. Archer) Staiger, *Biblioth. Lichenol.* **85:** 173 (2002); type: Australia, *Streimann* 9845 (CANB!—holotype).

Notes. Revision of type material of supposed *Graphis* species turned up two earlier names for the species named *Glyphis montoensis* by Staiger (2002). Both names were described in the same paper and probably from the same population, but since the type material of *Graphina atrofusca* (*Wilms* 70) is best developed, the epithet *atrofusca* is here selected for the species. The *Wilms* collections underline the ecological preference of this species for rather dry, partially exposed habitats.

Glyphis substriatula (Nyl.) Staiger.

Graphina sulcatula Müll. Arg., *Rev. Mycol.* **10:** 119 (1888); type Paraguay, *Balansa* s.n. (G!—holotype).

Graphina sulcatula var. *conglomerata* Müll. Arg., *Rev. Mycol.* **10:** 119 (1888); type: Paraguay, *Balansa* 4185 (G!—lectotype, selected here).

Graphina bakeri Zahlbr., *Ann. Mycol.* **2:** 269 (1904); *Graphina sulcatula* var. *bakeri* (Zahlbr.) Redinger, *Arkiv Bot.* **26A**(1)**:** 31 (1934); type: Nicaragua, *Baker* 2372 (W!—holotype).

Notes. Revision of type material of *Graphis* species revealed three synonyms of this widespread neotropical taxon, although the synonymy of *Graphina sulcatula* var. *conglomerata* is provisional; the type material has strongly aggregate lirellae and might represent a separate species.

Graphis apoda (Zahlbr.) Lücking comb. et stat. nov.

Graphis illinata var. *apoda* Zahlbr. in Magnusson & Zahlbruckner, *Ark. Bot.* **31A**(1)**:** 32 (1944); type: USA. (Hawaii), *Rock* 131 (W!—holotype).

Graphis brahmanensis Aptroot sp. nov.

Sicut *Graphis duplicata* sed thallo acido stictico continente differt.

Typus: Papua New Guinea, Madang, Ramu valley, Brahman, along road to Bundi, on branches of *Dipterocarpaceae* tree in virgin lowland rain forest, 200 m, August 1992, *Aptroot* 31685 (B!—holotypus).

(Fig. 13A)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae erumpent, with basal thalline margin, elongate and irregularly branched, 1–5 × 0·1–0·2 mm; labia eventually striate. *Excipulum* laterally carbonized; *hymenium* clear. *Ascospores* 8 per ascus, transversely 9–11-septate, 20–30 × 4–6 µm, hyaline.

Secondary chemistry. Stictic and hypostictic acid.

Notes. This new species is a typical representative of the *Graphis duplicata* group and

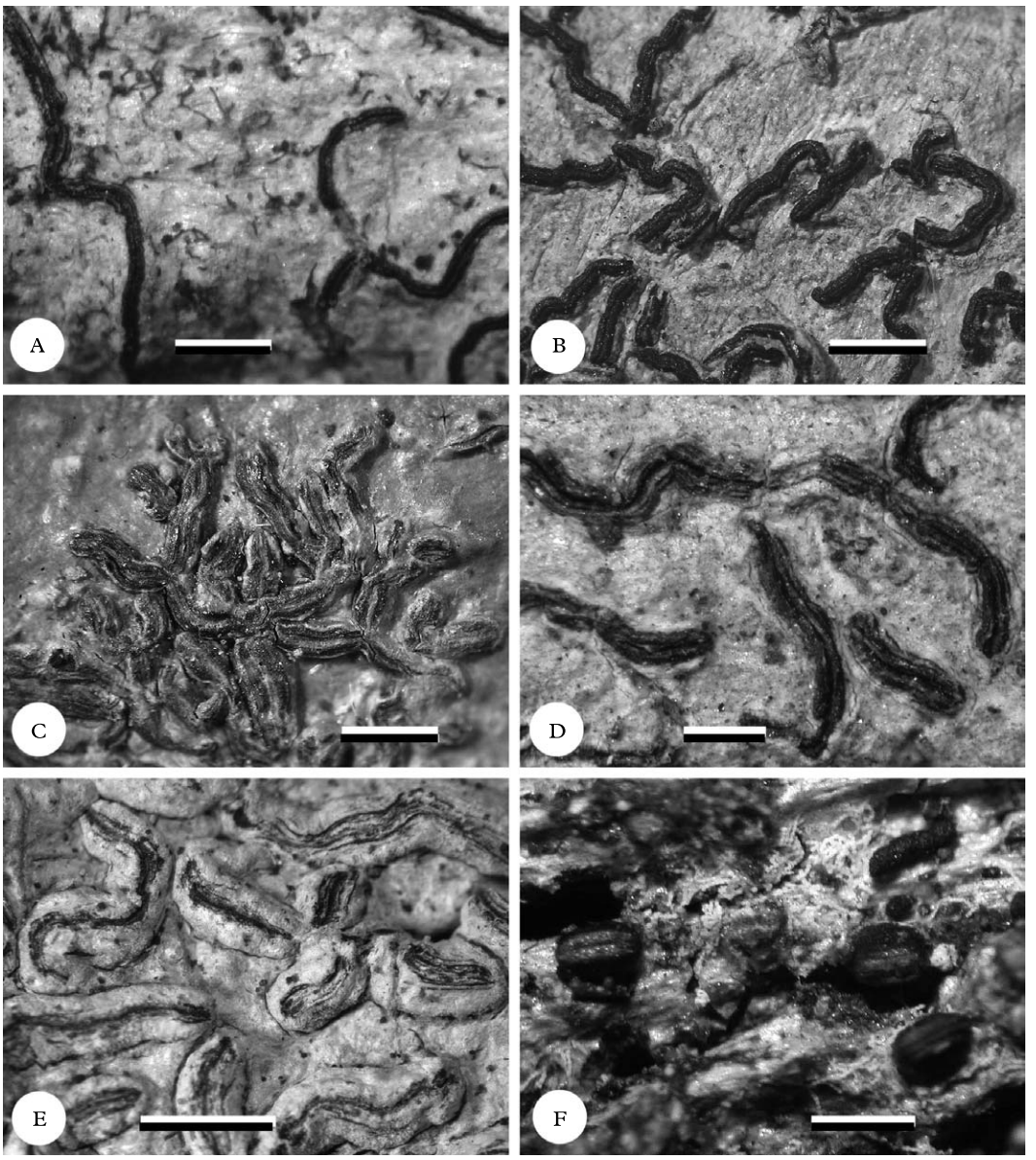

FIG. 13. New species in *Graphis* (all holotypes). A, *G. brahmanensis*; B, *G. cupei*; C, *G. evirescens* (new combination); D, *G. funilina*; E, *G. leucenae*; F, *G. lourdesina*. Scale = 1 mm.

differs from *G. duplicata* by the presence of stictic acid and the less prominent lirellae. *Graphis stenotera* is very similar in morphology and chemistry but has an apically carbonized excipulum only.

Graphis cincta (Pers.) Aptroot

Aptroot in Archer, *Fl. Australia* **57**: 651 (2009); *Opegrapha cincta* Pers., *Ann. Wetter. Ges.* **2:** 15 (1811); type: Dominican Republic, *s.col.* (L!—holotype; L!—isotypes).

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Graphis cremicolor (H. Magn.) Lücking & Archer comb. nov.

Graphina cremicolor H. Magn., *Ark. Bot., Ser. 2,* **3**(10)**:** 267 (1955); type: USA (Hawaii), *Faurie* 720 (UPS—holotype, not seen; Magnusson 1955).

Graphis cupei Vain. ex Lücking sp. nov.

Sicut *Graphis anfractuosa* sed ascosporis majoribus differt.

Typus Cuba, *Ekman* 19 (TUR-Vainio 27371!—holotypus).

(Fig. 13B)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae prominent, with basal thalline margin, elongate and irregularly branched, 1–5 × 0·3–0·4 mm; labia eventually striate. *Excipulum* completely carbonized; *hymenium* inspersed. *Ascospores* 4–8 per ascus, transversely 13–17-septate, 60–70 × 7–9 µm, hyaline.

Secondary chemistry. No substances detected.

Notes. Graphis cupei is here validated since it represents a distinct taxon with no other name available, characterized by the rather robust lirellae with inspersed hymenium and medium-sized ascospores and lacking secondary substances. Most similar is *G. anfractuosa* but that species has much smaller ascospores and completely lacks a thalline margin.

Graphis enteroleuca (Ach.) Lücking comb. nov.

Opegrapha enteroleuca Ach., *Syn. Meth. Lich.*: 78 (1814) [non Fée 1827 nec Nyl. 1853]; type: South America, unknown locality, *s.col.* (H-Acharius 658!—holotype).

Graphis galactoderma (Zahlbr.) Lücking comb. nov.

Graphina galactoderma Zahlbr. in Handel-Mazzetti, *Symb. Sin.* **3:** 54, 57 (1930); type: China, *Handel-Mazzetti* 5912 (W!).

Graphis evirescens (Redinger) Lücking comb. nov. (Fig. 13C).

Graphina evirescens Redinger, *Ark. Bot.* **26A(1):** 10, 43 (1933); type Brazil, *Malme* 3527 (S-5540!—holotype).

Graphis funilina Aptroot sp. nov.

Sicut *Graphis noumeana* sed ascosporis minoribus differt.

Typus: Brazil, Minas Gerais, Parque do Caraça, near Funil, on sandstone, 1350 m, September 1997, *Aptroot* 41306 (SP!—holotypus; ABL!—isotypus). Paratypes: same locality, same date, *Aptroot* 41305 (ABL, SP); same locality, along track to Varginha chapel, 1250 m, September 1997, *Aptroot* 41015 (ABL, SP).

(Fig. 13D)

Thallus corticate, smooth to uneven, white to pale yellowish grey.

Lirellae erumpent, with basal to lateral thalline margin, elongate and irregularly branched, 1–5 × 0·7–1·2 mm; labia striate. *Excipulum* completely carbonized; *hymenium* clear. *Ascospores* 8 per ascus, 7-septate, 30–40 × 10–12 µm, hyaline.

Secondary chemistry. No substances detected.

Notes. Most similar among species with small, transversely septate ascospores and lirellae with striate labia and completely carbonized excipulum is *G. aurita*, which differs in the much narrower lirellae and the smaller ascospores.

Graphis ingarum (Vain.) Lücking comb. et stat. nov.

Graphis angustata var. *ingarum* Vain., *Ann. Acad. Sci. Fenn., Ser. A*, **6(7):** 158 (1915). type: Guadeloupe, *Duss* 1190 (TUR-Vainio 27848!—holotype).

Graphis inspersolongula Aptroot sp. nov.

Sicut *Graphis longula* sed hymenio insperso et thallo acido norstictico continente differt.

Typus: Papua New Guinea, Central Province, Owen Stanley Range, Myola, on tree trunk at margin of primary montane forest, 2100 m, October 1995, *Aptroot* 37049 (B!—holotypus).

Thallus corticate, smooth to uneven, pale grey.

Lirellae erumpent, lacking thalline margin, short and sparsely branched, 1–3 × 0·4–0·7 mm; labia striate. *Excipulum* completely carbonized; hymenium inspersed (type A). *Ascospores* 8 per ascus, 13–19-septate, 75–100 × 15–20 µm, hyaline.

Secondary chemistry. Norstictic acid.

Notes. This species resembles *Graphis longula* but differs in the inspersed hymenium, the presence of norstictic acid, and the shorter lirellae.

Graphis isidiata (Hale) Lücking comb. nov.

Thelotrema isidiatum Hale, *Mycotaxon* **3:** 178 (1975); Type: Venezuela, *Hale* 42425 (US!—holotype).

Graphis japonica (Müll. Arg.) A. W. Archer & Lücking comb. nov.

Graphina japonica Müll. Arg., *Flora* **74:** 113 (1891); type: Japan, *Miyoshi* 23 (G!—holotype).

Graphis jeanmuelleri Lücking nom. nov.

Graphina elegantula Müll. Arg., *Flora* **63:** 23 (1880); non *Graphis elegantula* Zahlbr. in Handel-Mazzetti, *Symb. Sin.* **3:** 39, 50 (1930); type: Brazil, *Puiggari* s.n. (G!—holotype).

Graphis kousyuensis (Horik. & M. Nakan.) Lücking comb. nov.

Graphina kousyuensis Horik. & M. Nakan. in Nakanishi, *Journal of Science of the Hiroshima University, Series B, 2*, **11:** 93 (1966), 265 (1967); type: Japan, *Nakanishi* 1902 (HIRO—holotype, not seen).

Graphis leucaenae Aptroot sp. nov.

Sicut *Graphis cinerea* sed ascosporis minoribus et acidum norsticticum continente differt.

Typus: Indonesia (Java), Malang, Agricultural School gardens, on trunk of *Leucaena glauca*, March 1940, *Groenhart* 5190 (L!—holotype; B!—isotype).

(Fig. 13E)

Thallus corticate, smooth to uneven, pale grey.

Lirellae erumpent to prominent, with apically thin complete thalline cover (thick laterally), elongate and irregularly branched, 1–5 × 0·7–1·2 mm; labia striate. *Excipulum* completely carbonized; *hymenium* inspersed (type B). *Ascospores* 8 per ascus, 13–19-septate, 75–100 × 15–22 µm, hyaline.

Secondary chemistry. Norstictic acid.

Notes. This species is most similar to *Graphis cinerea*, but differs in the smaller ascospores (100–200 × 18–30 µm in the latter) and the rather thick lateral part of the thalline cover, as well as the presence of norstictic acid.

Graphis lourdesina Aptroot sp. nov.

Sicut *Graphis ruiziana* sed ascosporis majoribus differt.

Typus Brazil, Minas Gerais, Parque do Caraça, near Gruta de Lourdes, on bark of *Eucalyptus*, 1450 m, September 1997, *Aptroot* 41545 (SP!—holotypus; B!—isotypus).

(Fig. 13F)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae prominent to sessile, lacking thalline margin, very short and unbranched, 0·5–2·5 × 0·4–0·6 mm; labia entire. *Excipulum* completely carbonized; *hymenium* clear. *Ascospores* 2 per ascus, muriform, 100–120 × 30–35 µm, hyaline.

Secondary chemistry. No substances detected.

Notes. This new species is closely related to *Graphis ruiziana* and *G. subruiziana*, but differs in the large ascospores, which measure 35–65 × 10–20 µm in *G. ruiziana* (4–8 per ascus) and 60–80 × 20–30 µm in *G. subruiziana* (2–4 per ascus).

Graphis myolensis Aptroot sp. nov.

Sicut *Graphis lapidicola* sed lirellis prominentibus margine thallino basali differt.

Typus: Papua New Guinea, Central Province, Owen Stanley Range, Myola, along Iora creek, on tree trunk in primary montane forest, 2100 m, October 1995, *Aptroot* 37428 (B!).

Thallus corticate, smooth to uneven, white to pale yellowish grey.

Lirellae prominent, with basal thalline margin, short and sparsely branched, 1–4 × 0·2–0·4 mm; labia entire. *Excipulum* laterally carbonized; *hymenium* clear. *Ascospores* 8 per ascus, muriform, 60–70 × 11–13 µm, hyaline.

Secondary chemistry. No substances detected.

Notes. This new species is most similar to *Graphis lapidicola* and *G. xylophaga*, which differ chiefly in their erumpent lirellae with rather thick lateral to complete thalline margin.

Graphis nadurina Aptroot sp. nov.

Sicut *Graphis cleistomma* sed ascosporis minoribus differt.

Typus: Papua New Guinea, Central Province, Owen Stanley Range, surroundings of Naduri village, on tree trunk in secondary vegetation, 1600 m, October 1995, *Aptroot* 38161 (B!—holotypus). Paratypes: Papua New Guinea, Madang, Manam Isl., 450 m, Jul 1992, *Aptroot* 30513 (ABL); *ibid.*, Aug 1979, *Iserentant* 9364aa (ABL, LG).

(Fig. 14A)

Thallus corticate, smooth to uneven, pale yellowish grey.

Lirellae prominent to sessile, with apically thick complete thalline margin, very short and unbranched, 0·5–2·5 × 0·4–0·6 mm; labia entire. *Excipulum* (laterally to) completely carbonized; *hymenium* clear. *Ascospores* 2 per ascus, muriform, 40–50 × 14–16 µm, hyaline.

Secondary chemistry. Norstictic and connorstictic acids.

Notes. This new species is most similar to *Graphis cleistomma*, which differs in having much larger ascospores.

Graphis negrosina (Vain.) Lücking comb. et stat. nov.

Graphis duplicata var. *negrosina* Vain., *Ann. Acad. Sci. Fenn., Ser. A*, **15**(6)**:** 245 (1921); type: Philippines, *Merrill* 6790 (TUR-Vainio 27630!—holotype).

Graphis neoelongata Lücking nom. nov.

Graphis elongata Vain., *Acta Soc. Fauna Fl. Fenn.* **7:** 107 (1890); non *Graphis elongata* Zenker in Goebel & Kunze, *Pharmaceutische Waarenkunde* **1:** 165 (1829); type: Brazil, *s.col.* (TUR-Vainio 27202!—holotype).

Graphis norstictica Archer & Lücking sp. nov.

Sicut *Graphis borealis* sed ascosporis angustioribus differt.

Typus: Philippines, *Baker* 1253 (TUR-Vainio 27260!—holotypus).

(Fig. 14B)

Thallus corticate, smooth to uneven, white to pale yellowish grey.

Lirellae erumpent, with lateral thalline margin, elongate and irregularly branched, 1–5 × 0·2–0·3 mm; labia entire. *Excipulum* laterally carbonized; hymenium clear. *Ascospores* 8 per ascus, muriform, 35–50 × 17–25 µm, hyaline.

Secondary chemistry. Norstictic acid.

Notes. The type material of *G. nanodes* Vain. consists of two syntypes, one containing norstictic acid (*Baker* 1253) and the other no lichen substances (*Copeland* 1382). Since Vainio (1921) reported the thallus of *G. nanodes* as K−, the latter was selected as lectotype of that species. For the well-developed collection *Baker* 1253, no name is available, and it is here described as new. *Graphis norstictica* belongs in a group of three closely related species with similar lirella morphology and anatomy (*lineola*-morph) and similar chemistry, differing chiefly in ascospore size: *G. renschiana* with small ascospores 20–35 × 8–14 µm, *G. norstictica* with larger, narrow ascospores 35–50 × 10–16 µm, and *G borealis* with larger, broad ascospores 35–50 × 17–25 µm. The species is also known from Kenya and Papua New Guinea.

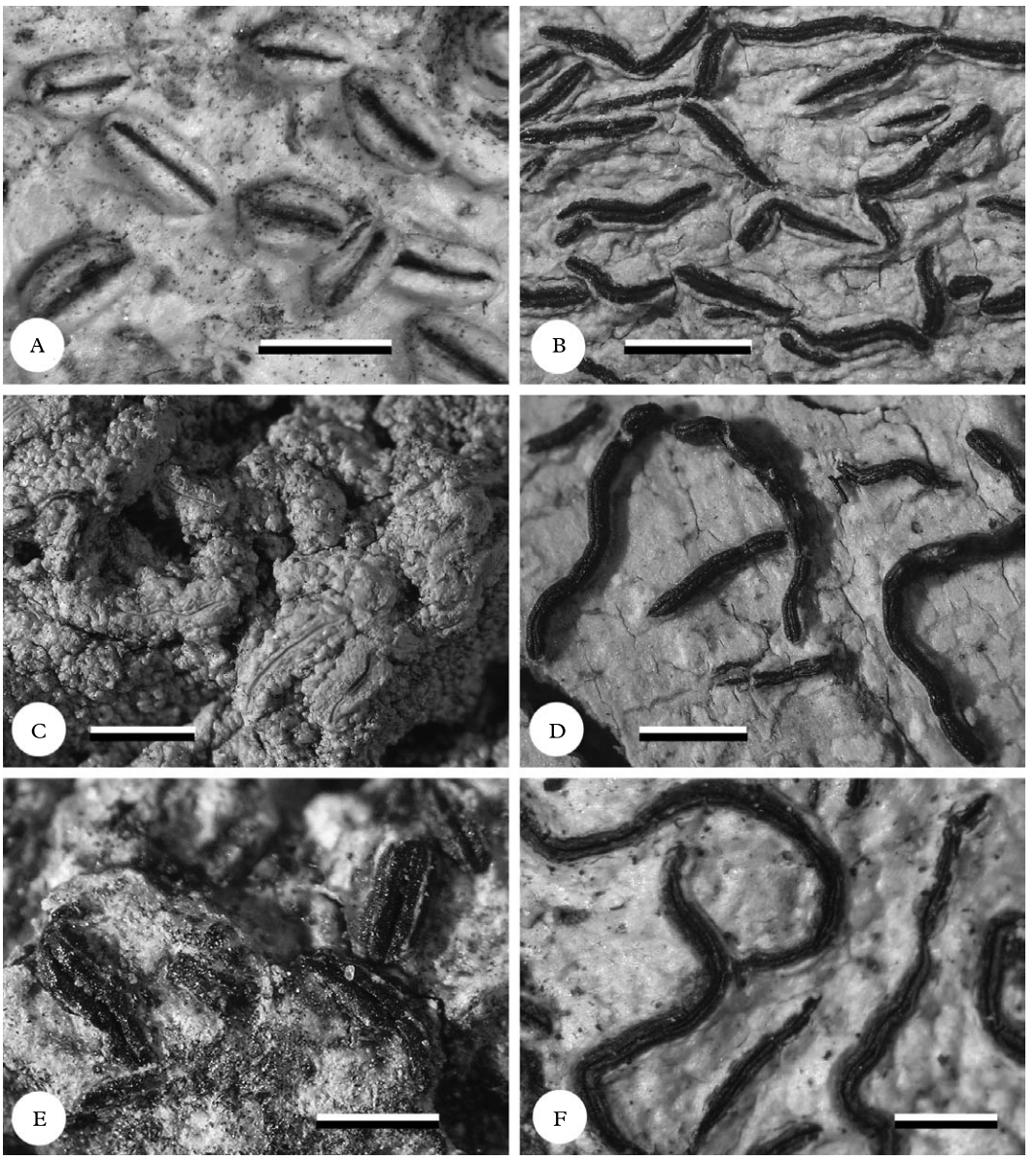

FIG. 14. New species in *Graphis* (all holotypes). A, *G. nadurina*; B, *G. norstictica*; C, *G. sarawakensis*; D, *G. slendrae*; E, *G. subintermedians*; F, *G. syzygii*. Scale = 1 mm.

Graphis novopalmicola A. W. Archer & Lücking nom. nov.

Graphina palmicola Müll. Arg., *Flora* **70:** 402 (1887); non *Graphis palmicola* Makhija & Adaw.; type: Australia, *Sayer* s.n. (G!—holotype).

Graphis oxyspora (Zahlbr.) Lücking comb. nov.

Graphina oxyspora Zahlbr., *Fedde Repert.* **31:** 214 (1933); type: Taiwan, *Asahina* 345 (W!—lectotype; US!—isolectotype).

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Graphis paralleloides Cáceres & Lücking nom. nov.

Graphis rimulosa var. *parallela* Müll. Arg., *J. Linn. Soc. Bot.* **29:** 224 (1882); *Graphis parallela* (Müll. Arg.) Cáceres & Lücking in Cáceres, *Libri Bot.* **22:** 84 (2007) [nom. illeg.; non *Graphis parallela* Müll. Arg.]; type: India, *Watt* s.n. (G!—holotype).

Graphis plumbea (Zahlbr.) Lücking comb. nov.

Graphina plumbea Zahlbr. in Handel-Mazzetti, *Symb. Sin.* **3:** 54, 55 (1930); type: China, *Chung* 602b (W!—lectotype).

Graphis riopiedrensis (Fink) Lücking comb. nov.

Graphina riopiedrensis Fink, *Mycologia* **19:** 217 (1927); type: Puerto Rico, *Fink* 2167 (MICH—holotype, not seen; FH!—isotype).

Graphis sarawakensis Hale ex Lücking sp. nov.

Sicut *Graphis subturgidula* sed ascosporis regulariter muriformibus latioribusque et thallo verrucoso differt.

Typus: Indonesia (Borneo: Sarawak), *Hale* 30435 (US!—holotype).

(Fig. 14C)

Thallus corticate, verrucose, white to pale grey.

Lirellae sessile, with thick complete, laterally verrucose thalline cover, elongate and irregularly branched, 1–5 × 0·4–0·6 mm; labia entire. *Excipulum* completely carbonized; hymenium clear. *Ascospores* 2–4 per ascus, muriform, 80–100 × 15–20 µm, hyaline.

Secondary chemistry. Stictic acid.

Notes. This species is most similar to the recently described *Graphis subturgidula* but differs in several features, notably the verrucose thallus, the sessile lirellae with rather thick thalline cover, and the regularly muriform, broader ascospores. *Graphis granulosa* is morphologically similar but has indistinctly striate labia and contains hypostictic acid.

Graphis semirigida (Müll. Arg.) Lücking comb. nov.

Graphina semirigida Müll. Arg., *J. Linn. Soc. London, Bot.*, **29:** 226 (1892); type: India, *Watt* 83 (G!—isotype).

Graphis slendrae Hale ex Lücking sp. nov.

Sicut *Graphis dupaxana* sed lirellis sessilibus radiatis differt.

Typus: Malaysia (Borneo: Sabah), *Hale* 28009 (US!—holotypus).

(Fig. 14D)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae prominent, with basal thalline margin, very long and radiately branched, 1–10 × 0·1–0·2 mm; labia striate. *Excipulum* completely carbonized; *hymenium* clear. *Ascospores* 8 per ascus, 5–7-septate, 25–35 × 5–7 µm, hyaline.

Secondary chemistry. No substances detected.

Notes. *Graphis slendrae* is most closely related to *G. dupaxana*, with which it shares lirellae with completely carbonized excipulum and striate labia, as well as small, transversely septate ascospores and lack of secondary substances. However, the sessile, very long and radiately branched lirellae of *G. slendrae* look very different from the prominent, comparatively short and sparsely branched lirellae of *G. dupaxana*.

Graphis subalbostriata Lücking nom. nov.

Graphis angustata var. *albostriata* Vain., *Ann. Acad. Sci. Fenn., Ser. A.*, **15**(6)**:** 158 (1915); non *Graphis albostriata* Vain., *Acta Soc. Fauna Fl. Fenn.* **7:** 103 (1890) ; typus Guadeloupe, *Duss* 517 (TUR-Vainio 27847!—holotypus).

Graphis subintermedians Hale ex Lücking sp. nov.

Sicut *Graphis pseudoserpens* sed ascosporis majoribus differt; type Malaysia (Borneo: Sabah), *Hale* 29240 (US!—holotype).

(Fig. 14E)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae erumpent (to prominent), with basal thalline margin, short and sparsely branched, 1–3 × 0·3–0·4 mm; labia striate. *Excipulum* laterally carbonized; *hymenium* clear. *Ascospores* 2 per ascus, muriform, 40–75 × 20–30 μm, hyaline.

Secondary chemistry. No substances detected.

Notes. This new species belongs in a small group of taxa with laterally carbonized excipulum, striate lirellae, clear hymenium, and muriform ascospores. Within this group, it is the only species lacking secondary substances and with ascospores exceeding 60 × 16 μm.

Graphis subradiata (Nyl.) Lücking comb. et stat. nov.

Graphis analoga var. *subradiata* Nyl., *Acta Soc. Sci. Fenn.* **7:** 465 (1863); Nylander, *Ann. Sci. Nat., Ser. 4,* **19:** 360 (1863); *Graphina analoga* var. *subradiata* (Nyl.) Zahlbr., *Cat. Lich. Univ.* **2:** 395 (1923); type: Colombia, *Lindig* 2725 (H-Nylander 7434!—holotype).

Graphis subserpens Staiger sp. nov.

Sicut *Graphis bettinae* sed ascosporis latioribus differt.

Typus: Brazil, *Kalb* 31118 (hb. Kalb!—holotypus).

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae prominent, with thick complete thalline margin, short and sparsely branched, 1–3 × 0·6–0·8 mm; labia entire. *Excipulum* completely carbonized; *hymenium* inspersed. *Ascospores* 4–8 per ascus, 9–19-septate, 80–120 × 20–30 μm, hyaline.

Secondary chemistry. No substances detected.

Notes. This species was treated as *nomen nudum* in Staiger (2002); it represents a distinct taxon, distinguished from the closely related *G. bettinae* by the much broader ascospores, and hence is validated here.

Graphis subtecta (Nyl.) Lücking comb. et stat. nov.

Graphis analoga var. *subtecta* Nyl., *Acta Soc. Sci. Fenn.* **7:** 465 (1863); type: Colombia, *Lindig* 2725 (H-Nylander 7408b!—holotype).

Notes. As can be seen from the key, this taxon has very little in common with *G. analoga*.

Graphis subvernicosa Lücking nom. nov.

Opegrapha vernicosa Fée, *Suppl. Essai Crypt. Écorc.*: 24 (1837) [non *Graphis vernicosa* Nyl., *Acta Soc. Sci. Fenn.* **7:** 466 (1863)]; *Graphina vernicosa* (Fée) Müll. Arg., *Flora* **63:** 41 (1880); Müller Argoviensis, *Mém. Soc. Phys. Hist. Nat. Genève* **29(8):** 41 (1887); type: America, *s.col.* (G—holotype, not seen).

Graphis sulphurella (Zahlbr.) Lücking comb. nov.

Graphina sulphurella Zahlbr., *Ann. Mycol.* **10:** 366 (1912); type: Hawaii, *Rock* 135 (W!—holotype).

Graphis syzygii Aptroot sp. nov.

Sicut *Graphis stenotera* sed excipulo lateraliter et basaliter carbonisato et hymenio insperso differt.

Typus: Costa Rica, Guanacaste, Volcán Tenerio National Park, 25 km NNW of Tilarán, along access road to station near Bijagua, on *Syzygium* tree in meadow, 700 m, March 2004, *Aptroot* 60569 (INB!—holotypus; B!—isotypus).

(Fig. 14F)

Thallus corticate, smooth to uneven, white to pale grey.

Lirellae erumpent, without or with basal thalline margin, elongate and irregularly branched, 1–5 × 0·2–0·3 mm; labia striate. *Excipulum* completely carbonized; *hymenium* inspersed. *Ascospores* 8 per ascus, transversely 9–13-septate, 25–35 × 5–7 μm, hyaline.

Secondary chemistry. Stictic acid.

Notes. This species closely resembles *Graphis stenotera* morphologically and chemically but differs in the completely carbonized excipulum and inspersed hymenium. The few

other species with striate labia, completely carbonized excipula, inspersed hymenia, and transversely septate ascospores, viz. *G. cinerea*, *G. leucaenae*, and *G. inspersolongula*, have much larger ascospores (75–200 × 15–30 μm).

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Index to and Checklist of Names and Synonyms of Graphis

Names in **boldface** are accepted epithets in *Graphis*; names in *italics* are synonyms, with accepted names indicated, or species in other genera likely to be confused with *Graphis* (*Carbacanthographis, Diorygma, Dyplolabia, Glyphis, Thecaria*). Letters a and b refer to first and second parts of each couplet, respectively

acharii Fée, Group 9: 19, Group 18: 8a

acharii var. *subintegra* Zahlbr. (*Graphina*), Group 9: 19a = *Graphis acharii* Fée

acromelaena Müll. Arg. (*Graphis*), Group 14: 6a = *Graphis parilis* Kremp.

acrophaea Müll. Arg. (*Graphis*), Group 14: 6a = *Graphis parilis* Kremp.

acuminata Vain. (*Graphis*), Group 14: 5b = *Graphis perstriatula* Nyl.

adpressa Vain., Group 8: 14a (Notes), 22a (Notes), 22b

adtenuans Nyl. (*Graphis*), Group 5: 5a = *Graphis subserpentina* Nyl.

afzelii (Ach.) A. Massal. (*Dyplolabia*), Group 4: 17a (Notes)

ajarekarii Patw. & C. R. Kulk., Group 4: 27a

albida Fink (*Graphis*), Group 8: 50a = *Graphis sitiana* Vain.

albidofarinacea Adaw. & Makhija, Group 8: 9a

albissima Müll. Arg., Group 4: 41a

alboglaucescens Adaw. & Makhija, Group 2: 7a

albostriata Vain. (*Graphis*), Group 13: 13a, Group 18: 10b = *Graphis dealbata* Nyl.

albotecta (Redinger) Staiger, Group 18: 14a
albotecta Redinger (*Graphina*), Group 18: 14a = *Graphis albotecta* (Redinger) Staiger
alloafzelii (A. W. Archer) A. W. Archer (*Carbacanthographis*), Group 4: 17a (Notes)
alpestris (Zahlbr.) Staiger, Group 3: 7a
altamirensis Sipman & Lücking, Group 20: 4a
alutacea Zahlbr. (*Phaeographina*), Group 5: 5a = *Graphis subserpentina* Nyl.
ambrizensis Vain. (*Graphis*), Group 7: 6a = *Graphis subvelata* Stirt.
amicta (Nyl.) Staiger & Kalb (*Carbacanthographis*), Group 9: 22b (Notes)
analoga Nyl., Group 5: 8a
analoga var. *nana* Vain. (*Graphis*), Group 5: 8a = *Graphis analoga* Nyl.
analoga var. *subradiata* Nyl. (Graphis), Group 18: 18b (Notes)
anfractuosa (Eschw.) Eschw., Group 10: 13a
angolensis C. W. Dodge (*Graphis*), Group 2: 9a [≡ *Graphis caesia* Müll. Arg.] = *Graphis glaucescens* Fée
anguilliformis Taylor (*Graphis*), Group 8: 18b = *Graphis rhizocola* (Fée) Lücking & Chaves
anguilliradians Lücking, Group 8: 28a
angustata Eschw., Group 17: 14a
angustata var. *albostriata* Vain. (*Graphis*), Group 13: 13a ≡ *Graphis subalbostriata* Lücking
angustata var. *denudata* Vain. (*Graphis*), Group 8: 27a = *Graphis flavens* Müll. Arg.
annulata Kremp. (*Graphis*), Group 14: 6a = *Graphis parilis* Kremp.
antillarum Vain., Group 14: 5a
antillarum var. *manilensis* Vain. (*Graphis*), Group 5: 10a = *Graphis renschiana* (Müll. Arg.) Stizenb.
aperiens Müll. Arg., Group 10: 5a
apertella A. W. Archer (*Graphis*), Group 6: 4a (Notes), Group 6: 6a = *Graphis crebra* Vain.
apoda (Zahlbr.) Lücking, Group 10: 4a
aquilonia (A. W. Archer) Staiger, Group 9: 7a, Group 18: 3b (Notes)
arbusculaeformis (Vain.) Lücking, Group 10: 13b
arecae Vain., Group 2: 5b
argentata Lücking & Umaña, Group 11: 7a, Group 20: 5b
argentia [*argentius*] **Makhija & Adaw.,** Group 4: 23a
asahinae Patw. & C. R. Kulk., Group 8: 39a
assamensis Nagarkar & Patw., Group 8: 11b
assimilis Nyl., Group 8: 42a
asterizans Nyl., Group 17: 16a
astrolirellata Lücking, Group 3: 10a
atrocelata (A. W. Archer) A. W. Archer, Group 5: 15a
atrofusca (Müll. Arg.) Lücking (*Glyphis*), Group 5: 21b (Notes), Group 9: 24b (Notes)
atrolabiata Chaves & Lücking (*Graphis*) [nom. inval.], Group 8: 27a = *Graphis flavens* Müll. Arg.
aurita Eschw., Group 17: 18a
awaensis Vain. (*Graphis*), Group 2: 2b (Notes), Group 4: 9b = *Graphis longiramea* Müll. Arg.
awasthii (Patw. & Nagarkar) Lücking, Group 5: 7a
bakeri Vain., Group 4: 24a
balansana Müll. Arg. (*Graphis*), Group 8: 6b (Notes)
batanensis Vain. (*Graphis*), Group 4: 34b = *Graphis dendrogramma* Nyl.
batanensis var. *rikuzensis* Vain. (*Graphis*), Group 2: 14a = *Graphis intermediella* Stirt.
bayatensis Vain. (*Graphis*) [nom. inval.], Group 2: 12b = *Graphis xanthospora* Müll. Arg.
bettinae Lücking, Umana, Chaves & Sipman, Group 10: 11a
bicrenatula Redinger (*Graphis*), Group 15: 12a = *Graphis striatula* (Ach.) Spreng.
bifera Zahlbr., Group 8: 14a
bifera var. *cinerea* Zahlbr. (*Graphis*), Group 4: 13a = *Graphis hossei* Vain.
bilabiata Nyl., Group 3: 3a
bipartita (Müll. Arg.) Lücking, Group 14: 4b
bipartita Müll. Arg. (*Graphina*), Group 14: 4b = *Graphis bipartita* (Müll. Arg.) Lücking
borealis (A. W. Archer) A. W. Archer, Group 5: 11a
bougainvillei Zahlbr. (*Graphis*), Group 4: 34b = *Graphis dendrogramma* Nyl.
brahmanensis Aptroot, Group 15: 7b
breussii Neuwirth & Lücking, Group 18: 6a
brevicarpa M. Nakan., Kashiw. & K. H. Moon, Group 6: 8a
britannica Staiger, Group 3: 6b
bulacana Vain. (*Graphis*), Group 2: 9a = *Graphis glaucescens* Fée
caesia Müll. Arg. (*Graphis*), Group 2: 9a [≡ *Graphis angolensis* C. W. Dodge] = *Graphis glaucescens* Fée
caesiella Vain., Group 4: 26b, Group 17: 4a (Notes)
caesiocarpa Redinger, Group 8: 41a
caesioglauca Redinger (*Graphis*), Group 13: 16a = *Graphis glaucescens* Fée
calcea (Fée) A. Massal., Group 17: 14b
calcea A. Massal. (*Opegrapha*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
candidata (Nyl.) Staiger & Kalb (*Carbacanthographis*), Group 8: 2a (Notes), Group 8: 4b (Notes)
capillacea Stirt., Group 4: 21a
carassensis Vain., Group 9: 19b
carbocarpa Redinger (*Graphina*), Group 18: 12a = *Graphis macella* Kremp.
caribica Lücking, Group 13: 14a
castanopsidis Zahlbr. (*Graphis*), Group 4: 41b = *Graphis pinicola* Zahlbr.
catherinae A. W. Archer (*Graphis*), Group 8: 26a = *Graphis seminuda* Müll. Arg.
celata (A. W. Archer) A. W. Archer (*Graphis*) [nom. illeg.], Group 3: 6a ≡ *Graphis coenensis* A. W. Archer
celata Stirt., Group 3: 6a (homonym), Group 15: 6a
celtidis Müll. Arg. (*Graphis*), Group 4: 28b = *Graphis librata* C. Knight
centrifuga Räsänen, Group 10: 7a
cerviculata Redinger (*Phaeographis*), Group 18: 2a = *Graphina vestitoides* Fink
cervina Müll. Arg., Group 8: 39b
cervinonigra Zahlbr., Group 10: 8a
ceylanica Zahlbr. (*Graphis*), Group 4: 34b [≡ *Graphis irradians* Nyl.] = *Graphis dendrogramma* Nyl.
chartarna F. Wilson (*Graphina*) [nom. inval.], Group 5: 19a = *Graphis daintriensis* (A. W. Archer) A. W. Archer

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chionophora (Redinger) Staiger & Kalb (*Carbacanthographis*), Group 8: 2a (Notes)
chloroalba Makhija & Adaw., Group 13: 16b
chlorotica A. Massal., Group 13: 20a
chondroplaca (Redinger) Lücking (*Graphis*), Group 6: 6b (Notes) = *Graphis handelii* Zahlbr.
chromothecia R. C. Harris, Group 1: 10a
chrysocarpa (Raddi) Spreng., Group 1: 8b
chungii Zahlbr. (*Graphis*), Group 17: 16b = *Graphis glauconigra* Vain.
chungii var. *oligospora* Zahlbr. (*Graphis*), Group 17: 16b = *Graphis glauconigra* Vain.
cincta (Pers.) Aptroot, Group 6: 8b, Group 8: 42a (Notes)
cincta Pers. (*Opegrapha*), Group 6: 8b = *Graphis cincta* (Pers.) Aptroot
cinerea Fée, Group 19: 2a
cinereoides Lücking & Chaves (*Graphis*) [nom. inval.], Group 20: 5b = *Graphis argentata* Lücking & Umaña
cinnamomea Adaw. & Makhija, Group 8: 38a
cleistoblephara Nyl., Group 9: 8b
cleistomma Nyl., Group 9: 17a
cleitops (Fée) Lücking (*Carbacanthographis*), Group 5: 12b (Notes), Group 5: 13a (Notes)
coarctata Stirt., Group 2: 13a
coccospora (Aptroot) Aptroot & Lücking (*Carbacanthographis*), Group 9: 19b (Notes)
coenensis A. W. Archer [≡ *Graphis celata* (A. W. Archer) A. W. Archer], Group 3: 6a
cognata Müll. Arg., Group 8: 20a
colliculoides Adaw. & Makhija (*Graphis*), Group 8: 42b = *Graphis intricata* Fée
comma (Ach.) Spreng., Group 9: 33a
comma Eschw., Group 9: 33a [nom. illeg.]
componens Nyl., Group 18: 5a
compulsa Kremp. (Graphis) [nom. illeg.], Group 10: 6a ≡ *Graphis desquamescens* (Fée) Zahlbr.
conferta Zenker, Group 8: 44a
confinis C. Knight (*Graphis*), Group 8: 42b = *Graphis intricata* Fée
confluens (Fée) Kalb, Staiger & Elix (*Diorygma*), Group 9: 4b (Notes)
congesta (Fée) Müll. Arg., Group 18: 3a
conglomerata Fée (*Opegrapha*) [nom. illeg.], Group 8: 18a ≡ *Graphis feeana* Lücking
conglomerata Pers. (*Opegrapha*) [homonym], Group 8: 18a
connectens Zahlbr. (*Graphis*), Group 4: 13a = *Graphis hossei* Vain.
consanguinea (Müll. Arg.) Lücking, Group 18: 12b
consanguinea Müll. Arg. (*Graphina*), Group 18: 12b = *Graphis consanguinea* (Müll. Arg.) Lücking
consimilis Vain., Group 5: 25a
contortuplicata Müll. Arg., Group 15: 9a, Group 17: 12b
cooperta Zenker (*Graphis*), Group 8: 18b = *Graphis rhizocola* (Fée) Lücking & Chaves
copelandii Vain., Group 5: 4a
crassa (Müll. Arg.) Staiger & Kalb (*Carbacanthographis*), Group 9: 4b (Notes)
crassilabra Müll. Arg., Group 4: 10b
crebra Vain., Group 6: 4a (Notes), Group 6: 6a
cremicolor (H. Magn.) Lücking & Archer, Group 9: 23b
crystallifera Redinger (*Graphina*), Group 18: 11a = *Graphis myrtacea* (Müll. Arg.) Lücking
cuiabensis Staiger (*Graphis*) [nom. inval.], Group 15: 3a = *Graphis haleana* R. C. Harris
cupei Vain. ex Lücking, Group 10: 12a
curta Fée (*Graphis*), Group 18: 8a = *Graphis acharii* Fée
curtiuscula Zahlbr., Group 8: 14b
cycasicola A. W. Archer & Elix, Group 9: 8a
daintriensis (A. W. Archer) A. W. Archer, Group 5: 19a
daintriensis A. W. Archer (*Graphina*), Group 5: 19a = *Graphis daintriensis* (A. W. Archer) A. W. Archer
dealbata Nyl., Group 18: 10b
dehiscens Stirt. (*Schistostoma*), Group 6: 6b = *Graphis handelii* Zahlbr.
dehiscens Vain. (*Graphis*) [homonym], Group 6: 6b
deightonii C. W. Dodge (*Graphis*), Group 6: 12b = *Graphis lineola* Ach.
dendrogramma Nyl., Group 4: 34b
descissa Müll. Arg., Group 8: 35b
deserpens Vain., Group 5: 12a
desquamescens (Fée) Zahlbr., Group 10: 6a
diaphoroides Müll. Arg. (*Graphis*), Group 4: 28b = *Graphis librata* C. Knight
dichotoma (Müll. Arg.) Lücking, Group 16: 3a
dichotoma Müll. Arg. (*Graphina*), Group 16: 3a = *Graphis dichotoma* (Müll. Arg.) Lücking
dimidiata Vain., Group 3: 10b
diplocheila Vain., Group 7: 5b
discarpa A. W. Archer, Group 8: 32a
dispersa Makhija & Adaw. (*Graphis*) [nom. illeg.], Group 8: 25a = *Graphis subdisserpens* Nyl.
dispersa Redinger (*Graphis*) [homonym], Group 8: 25a
disserpens Nyl. (Graphis) [homonym], Group 13: 21b
disserpens Nyl., Group 14: 11b
disserpens Vain. (*Graphis*) [nom. illeg.], Group 13: 21b ≡ *Graphis proserpens* Vain.
distincta Makhija & Adaw., Group 4: 30a
dolichographa Nyl., Group 9: 15a, Group 9: 30b
dracaenae Vain., Group 8: 48b
dupaxana Vain., Group 17: 20b
duplicata Ach., Group 15: 13a
duplicata var. *australasiatica* Vain. (*Graphis*), Group 13: 20a = *Graphis chlorotica* A. Massal.
duplicatoinspersa Lücking, Main key: 17a
dussii Vain., Group 4: 5a
eburnea Adaw. & Makhija, Group 2: 7b
eimeoensis A. W. Archer & Elix (*Graphis*), Group 10: 8b = *Graphis gonimica* Zahlbr.
elegans (Sm.) Ach., Group 15: 5a
elegantula Müll. Arg. (Graphina), Group 9: 32a ≡ *Graphis jeanmuelleri* Lücking
elegantula Zahlbr., Group 2: 5a, Group 9: 32a (Notes)
elixiana A. W. Archer, Group 11: 6a
elixii A. W. Archer (*Graphis*), Group 11: 6a (Notes)
elixii A. W. Archer (*Phaeographis*), Group 11: 6a ≡ *Graphis elixiana* A. W. Archer
elmeri Vain., Group 9: 6a

elongata Vain. (*Graphis*) [nom. illeg.], Group 16: 1a ≡ *Graphis neoelongata* Lücking
elongata Zenker, Group 4: 15b, Group 16: 1a
elongatoradians Fink (*Graphina*), Group 16: 3a = *Graphis dichotoma* (Müll. Arg.) Lücking
emersa Müll. Arg., Group 8: 36a
endoschiza Müll. Arg. (*Graphina*), Group 16: 4b = *Graphis puiggarii* (Müll. Arg.) Lücking
endoxantha Asahina (*Graphis*) [nom. illeg.], Group 13: 21b (Notes)
endoxantha Nyl., Group 13: 19a, Group 13: 21b (Notes)
enteroleuca (Ach.) Lücking, Group 4: 39b
enteroleuca Fée (*Opegrapha*) [nom. illeg.], Group 4: 39b
enteroleuca Nyl. (*Opegrapha*) [nom. illeg.], Group 4: 39b
epiglaucum (Müll. Arg.) Kalb, Staiger & Elix (*Diorygma*), Group 9: 4b (Notes)
epimelaena Müll. Arg., Group 2: 10a
epiphloea Zahlbr., Group 2: 2b
erythrocardia Müll. Arg., Group 4: 6a
evirescens (Redinger) Lücking, Group 5: 24a
exalbata Nyl., Group 13: 5a
farinulenta Müll. Arg., Group 4: 12b
feeana Lücking, Group 8: 18a
ferruginea Vain., Group 1: 5a
ficicola Vain., Group 8: 40a
filiformis Adaw. & Makhija, Group 4: 28a
filiformis Zahlbr. (*Graphina*), Group 3: 4b = *Graphis japonica* (Müll. Arg.) A. W. Archer & Lücking
firferi Lücking, Group 1: 4a
fissofurcata Leight. (*Graphis*), Group 5: 13a = *Graphis streblocarpa* (Bél.) Nyl.
flabellans Zahlbr. (*Graphis*), Group 13: 9a = *Graphis vittata* Müll. Arg.
flavens Müll. Arg., Group 8: 27a
flavicans Müll. Arg. (*Graphis*), Group 17: 15a = *Graphis longula* Kremp.
flavoaltamirensis Sipman & Lücking, Group 1: 3a
flavominiata Moncada & Lücking, Group 1: 4b
flavovirens Makhija & Adaw., Group 8: 35a
flexibilis Kremp. (*Graphis*), Group 17: 14a = *Graphis angustata* Eschw.
foliicola Vain. (*Graphis*), Group 4: 40a = *Graphis furcata* Fée
foliicola var. *major* Awasthi & Singh (*Graphis*), Group 4: 41b = *Graphis pinicola* Zahlbr.
formosana Zahlbr. (*Graphis*), Group 8: 6a = *Graphis subassimilis* Müll. Arg.
fournierii Lizano & Lücking, Group 18: 13a
fruticicola Vain. (*Graphis*), Group 18: 2a = *Graphina vestitoides* Fink
fujianensis Z. F. Jia & J. C. Wei, Group 9: 22a
fumosa Müll. Arg., Group 17: 8a
funilina Aptroot, Group 17: 17a
furcata Fée, Group 4: 40a
galactoderma (Zahlbr.) Lücking, Group 14: 7b
garoana Nagarkar & Patw. (*Graphis*), Group 4: 7b
geraensis Redinger (*Graphis*), Group 8: 48b = *Graphis dracaenae* Vain.
glaucescens Fée, Group 2: 9a, Group 2: 10a (Notes), Group 13: 16a
glaucocaesia Müll. Arg. (*Graphis*), Group 2: 9a = *Graphis glaucescens* Fée
glauconigra Vain., Group 17: 16b
glaucovirens Redinger (*Graphis*), Group 2: 12a = *Graphis sayeri* Müll. Arg.
globosa (Fée) Spreng., Group 9: 11b
globosa Aptroot (*Topeliopsis*), Group 9: 11a = *Graphis mexicana* (Hale) Lücking, Lumbsch & Kalb
globosa Fée (*Opegrapha*), Group 9: 11b = *Graphis globosa* (Fée) Spreng.
gloriosensis A. W. Archer & Elix, Group 10: 4b
gomezii Lücking, Will-Wolf & Umaña, Group 9: 30a
gonimica Zahlbr., Group 10: 8b
gracilescens Vain. (*Graphis*), Group 14: 5b = *Graphis perstriatula* Nyl.
gracilis (Eschw.) Leight. (*Graphis*), Group 5: 10a (Notes)
gracilis (Fr.) Leight. (*Graphis*), Group 5: 10a (Notes)
gracilis Eschw. (*Ustalia*), Group 5: 10a (Notes)
gracilis Fée (*Opegrapha*) [homonym], Group 5: 10a
gracilis Fr. (*Opegrapha*), Group 5: 10a = *Graphis renschiana* (Müll. Arg.) Stizenb.
granulata Fée, Group 17: 12a
granulocarpa Redinger, Group 13: 18a
granulosa (Müll. Arg.) Lücking, Group 18: 10a
gregmuelleri Sipman & Lücking, Group 12: 1a
guimarana Vain. (*Graphis*), Group 6: 8b = *Graphis cincta* (Pers.) Aptroot
guineensis C. W. Dodge (*Graphis*), Group 4: 41b = *Graphis pinicola* Zahlbr.
haleana R. C. Harris, Group 15: 3a
handelii Zahlbr., Group 6: 6b
hartmanniana Müll. Arg. (*Graphina*), Group 9: 26b (Notes)
hemisphaerica Vain. (*Graphis*), Group 9: 11b = *Graphis globosa* (Fée) Spreng.
hertelii Kalb & Staiger (*Carbacanthographis*), Group 4: 29a (Notes)
heteroplacoides Redinger (*Graphina*), Group 18: 12b = *Graphis consanguinea* (Müll. Arg.) Lücking
hiascens (Fée) Nyl., Group 5: 7b
hiascens var. *clausior* Vain. (*Graphis*), Group 3: 4a = *Graphis streblocarpa* (Bél.) Nyl.
hillii (A. W. Archer) A. W. Archer (*Carbacanthographis*), Group 9: 2a (Notes)
hossei Vain., Group 4: 13a
hunana Zahlbr. (*Graphis*), Group 8: 42b = *Graphis intricata* Fée
hunanensis (Zahlbr.) M. Nakan. & Kashiw., Group 18: 6b
hyphosa Staiger, Group 8: 43a
hypocrellinea Lücking & Chaves, Group 1: 11b
ignea Kremp. (*Graphis*), Group 1: 8b (Notes)
illinata Eschw., Group 9: 18a
illota Müll. Arg. (*Graphis*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
illota var. *leopoldensis* Redinger (*Graphis*), Group 8: 18b = *Graphis rhizocola* (Fée) Lücking & Chaves
immersa Fink (*Graphis*), Group 12: 2b (Notes), Group 17: 18a = *Graphis aurita* Eschw.
immersa Müll. Arg. (*Graphina*), Group 12: 2b ≡ *Graphis immersoides* Lücking

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meridionalis M. Nakan. (*Graphis*), Group 8: 36a = *Graphis emersa* Müll. Arg.
mexicana (Hale) Lücking, Lumbsch & Kalb, Group 9: 11a
mexicanum Hale (*Thelotrema*), Group 9: 11a = *Graphis mexicana* (Hale) Lücking, Lumbsch & Kalb
mindanaoensis Vain. (*Graphis*), Group 2: 12b = *Graphis xanthospora* Müll. Arg.
miniata Redinger, Group 1: 7a
mirabilis Lücking, Sipman, Umaña & Chaves, Group 12: 1a
modesta Zahlbr., Group 8: 31a
moultonii Vain. (*Graphis*), Group 17: 20b = *Graphis dupaxana* Vain.
multibrachiata Zahlbr. (*Graphis*), Group 4: 9b = *Graphis longiramea* Müll. Arg.
multisulcata (Müll. Arg.) Lücking & Chaves, Group 18: 18a
muscicola Kalb (*Graphina*), Group 9: 11a = *Graphis mexicana* (Hale) Lücking, Lumbsch & Kalb
myolensis Aptroot, Group 5: 20a
myrtacea (Müll. Arg.) Lücking, Group 18: 11a
myrtacea Müll. Arg. (*Graphina*), Group 18: 11a = *Graphis myrtacea* (Müll. Arg.) Lücking
nadurina Aptroot, Group 5: 9a, Group 9: 23a
nana (Fée) Spreng., Group 4: 38a
nanodes Vain., Group 5: 25b
negrosina (Vain.) Lücking, Group 8: 52b
nematodiza Vain. (*Graphis*), Group 4: 13a = *Graphis hossei* Vain.
nematoides Leight., Group 2: 6a, Group 4: 24b
neoelongata Lücking, Group 16: 1a
nerurensis Makhija, A. Dube, Adaw. & Chitale (*Graphis*), Group 13: 5a = *Graphis exalbata* Nyl.
nigrocarpa Adaw. & Makhija, Group 8: 11a
nigroglauca Leight., Main key: 17a (Notes), Group 13: 6a
nilgiriensis Adaw. & Makhija, Group 17: 8b
njalensis C. W. Dodge (Graphis), Group 8: 49a = *Graphis oxyclada* Müll. Arg.
norstictica A. W. Archer & Lücking, Group 5: 11b
norvestitoides Sutjaritturakan, Group 9: 7a (Notes), Group 18: 3b
noumeana Müll. Arg. (*Graphis*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
novopalmicola A. W. Archer & Lücking, Group 11: 4a
nuda (Magn.) Staiger & Lücking, Group 9: 27a
nuda Staiger (*Graphis*) [nom. inval.], Group 8: 22a = *Graphis ovata* (Fée) A. Massal.
nudaeformis Lücking, Group 8: 17a
nylanderi Patw. & C. R. Kulk. (*Graphina*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
nylanderiana Patw. & C. R. Kulk. (*Graphina*) [nom. illeg.], Group 18: 12b
nylanderiana Zahlbr. (*Graphina*), Group 18: 12b = *Graphis consanguinea* (Müll. Arg.) Lücking
ocellata Zahlbr. (*Graphis*), Group 8: 35b (Notes)
ochracea C. W. Dodge (*Phaeographis*), Group 1: 8a ≡ *Graphis subchrysocarpa* Lücking
ochracea Hepp (*Graphis*) [homonym], Group 1: 8a
oligospora Zahlbr., Group 2: 2a
olivacea Redinger, Group 13: 13b
orientalis Vain. (*Graphis*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
oryzaecarpa Lücking, Group 9: 14a
oryzoides (Leight.) Kalb & Staiger (*Dyplolabia*), Group 5: 1a (Notes)
ovata (Fée) A. Massal., Group 8: 22a
ovata Fée (*Opegrapha*), Group 8: 22a = *Graphis ovata* (Fée) A. Massal.
overeemii Zahlbr. (*Graphis*), Group 8: 6a = *Graphis subassimilis* Müll. Arg.
oxyclada Müll. Arg., Group 8: 49a
oxyspora (Zahlbr.) Lücking, Group 18: 16b
pachypleura Müll. Arg. (*Graphina*), Group 18: 8a = *Graphis acharii* Fée
palmicola Makhija & Adaw., Group 8: 46a, Group 11: 4a (Notes)
palmicola Müll. Arg. (Graphina), Group 11: 4a ≡ *Graphis novopalmicola* A. W. Archer & Lücking
palmyrensis Zahlbr. (*Graphis*), Group 4: 28b, Group 4: 41b (Notes) = *Graphis librata* C. Knight
paradisserpens Sipman & Lücking, Group 14: 12b
parallela Müll. Arg., Group 8: 15a, Group 17: 4b [homonym]
paralleloides Cáceres & Lücking, Group 17: 4b
paraserpens Lizano & Lücking, Group 14: 12a
parilis Kremp., Group 14: 6a
patwardhanii C. R. Kulk., Group 13: 11a
pauaiensis Vain. (*Graphis*) Group 18: 4a (Notes)
pauciloculata Coppins & P James (*Graphina*), Group 5: 14b (Notes)
pavoniana Fée, Group 4: 12a
pedunculata Bungartz & Aptroot, Group 8: 7a
peralbida Nyl. (*Graphis*), Group 14: 4b = *Graphis bipartita* (Müll. Arg.) Lücking
pergracilis (Zahlbr.) Lücking & A. W. Archer, Group 3: 9a
pernambucoradians Cáceres & Lücking, Group 8: 51a
persicina G. Mey. & Flot., Group 1: 11a
perstriatula Nyl., Group 14: 5b
persulcata Stirt. (*Graphis*), Group 17: 18a = *Graphis aurita* Eschw.
pertricosa (Kremp.) A. W. Archer, Main key: 4a, Group 7: 3a
petrophila Zahlbr. (*Graphina*), Group 3: 4b = *Graphis japonica* (Müll. Arg.) A. W. Archer & Lücking
phaeospora Vain., Group 11: 7b, Group 20: 5a
pilarensis Cáceres & Lücking, Group 7: 6b
pinicola Zahlbr., Group 4: 28b (Notes), Group 4: 41b, Group 10: 8b (Notes)
pittieri Lücking, Umaña, Sipman & Chaves, Group 8: 21a
plagiocarpa Fée, Group 9: 14b
platycarpa Eschw., Group 14: 9b
platycarpoides Vain. (*Graphis*), Group 14: 5a = *Graphis antillarum* Vain.
plumbea (Zahlbr.) Lücking, Group 18: 16a
plumierae Vain., Group 6: 7a
plurispora (Redgr.) Lücking & Chaves, Group 18: 17a

polillensis Vain., Group 9: 28a
polyclades Kremp., Group 7: 5a
polyschizans Vain. (*Graphis*) [nom. inval.], Group 14: 5b = *Graphis perstriatula* Nyl.
polystriata Makhija & Dube, Group 15: 9b
propinqua Müll. Arg. (*Graphis*), Group 8: 25a = *Graphis subdisserpens* Nyl.
proserpens Vain., Group 13: 19b (Notes), Group 13: 21b
prosiliens (Mont. & Bosch) A. Massal. (*Thecographa*), Group 9: 15a (Notes)
prunicola Vain., Group 4: 39a
pseudoanaloga Vain., Group 20: 2a
pseudocinerea Lücking & Umaña, Group 20: 3a
pseudoserpens Chaves, Lücking & Umaña, Group 16: 4a
pseudoserpentina Chaves & Lücking (*Graphis*) [nom. inval.], Group 3: 7b = *Graphis subcontorta* (Müll. Arg.) Lücking & Chaves
pseudosophistica Vain. (*Graphina*), Group 18: 12b = *Graphis consanguinea* (Müll. Arg.) Lücking
psidii Groenh. (*Graphis*), Group 4: 13a = *Graphis hossei* Vain.
puiggarii (Müll. Arg.) Lücking, Group 16: 4b
puiggarii Müll. Arg. (*Graphina*), Group 16: 4b = *Graphis puiggarii* (Müll. Arg.) Lücking
pulverulenta (Pers.) Ach. (*Graphis*) [homonym], Group 3: 6b
pulverulenta Sm. & Sowerby (*Opegrapha*) [nom. illeg.], Group 3: 6b ≡ *Graphis britannica* Staiger
pyrrhocheila Mont. & Bosch (*Graphis*) [homonym], Group 4: 26a
pyrrhocheila Vain. (*Graphis*) [nom. illeg.], Group 4: 26a ≡ *Graphis pyrrhocheiloides* Zahlbr.
pyrrhocheiloides Zahlbr., Group 3: 9b (Notes), Group 4: 26a
quassiicola Fée (*Thecaria*), Group 2: 14a (Notes)
ramificans Nyl. (*Graphis*), Group 15: 5a (Notes)
regularis Müll. Arg., Group 8: 24b
reniforme (Fée) Kalb, Staiger & Elix (*Diorygma*), 9: 6b (Notes)
renschiana (Müll. Arg.) Stizenb., Group 5: 10a
renschiana Müll. Arg. (*Graphina*), Group 5: 10a = *Graphis renschiana* (Müll. Arg.) Stizenb.
rhabdotis Fée (*Opegrapha*), Group 15: 5a = *Graphis elegans* (Sm.) Ach.
rhizocola (Fée) Lücking & Chaves, Group 8: 18b
rhizocola Fée (*Opegrapha*), Group 8: 18b = *Graphis rhizocola* (Fée) Lücking & Chaves
rigidula Müll. Arg. (*Graphis*), Group 15: 12b = *Graphis leptoclada* Müll. Arg.
rimulosa (Mont.) Trevis., Group 17: 20a
rimulosa Mont. (*Opegrapha*), Group 17: 20a = *Graphis rimulosa* (Mont.) Trevis.
rimulosa Redinger (*Graphina*), Group 18: 14a = *Graphis albotecta* (Redinger) Staiger
rimulosa subsp. *lignicola* Fink (*Graphis*), Group 15: 12b = *Graphis leptoclada* Müll. Arg.
rimulosa var. *brachycarpa* Müll. Arg. (*Graphis*), Group 17: 20a = *Graphis rimulosa* (Mont.) Trevis.
rimulosa var. *parallela* Müll. Arg. (*Graphis*), Group 17: 4b ≡ *Graphis paralleloides* Cáceres & Lücking
rimulosa var. *tetraspora* Redinger (*Graphis*), Group 15: 3b = *Graphis lucifica* R. C. Harris
riopiedrensis (Fink) Lücking, Group 4: 31a
robusta Müll. Arg. (*Graphina*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
rockii Redinger (*Graphis*), Group 13: 19b = *Graphis tsunodae* Zahlbr.
rongklaensis Sutjaritturakan [≡ *Graphina vestita* M. Nakan., Kashiw. & K. H. Moon], Group 5: 6a
rubiginosa (Fée) Staiger (*Fissurina*), Group 3: 9b (Notes)
rubricosa Fée (*Graphis*), Group 1: 8b (Notes)
rudescens Nyl. (*Graphina*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
rugulosa Fée (*Opegrapha*), Group 8: 16a = *Graphis tumidula* (Fée) Spreng.
ruiziana (Fée) A. Massal., Group 9: 27b
rustica Kremp., Group 8: 5a
salacinilongiramea Adaw. & Makhija, Group 4: 7a
salazinica (A. W. Archer) A. W. Archer (*Carbacanthographis*), Group 9: 20a (Notes)
sapii Zahlbr. (*Graphis*), Group 10: 8b = *Graphis gonimica* Zahlbr.
sarawakensis Hale ex Lücking, Group 9: 4b
sauroidea Leight., Group 8: 2a
saxicola (Müll. Arg.) A. W. Archer, Group 11: 5b
saxiseda (Zahlbr.) Bungartz (*Carbacanthographis*), Group 3: 1b (Notes)
saxorum (Egea & Torrente) Bungartz (*Carbacanthographis*), Group 4: 24a (Notes)
sayeri Müll. Arg., Group 2: 12a
scaphella Ach., Group 9: 25a
schiffneri Zahlbr., Group 17: 4a
schizogrupta Müll. Arg. (*Graphis*), Group 15: 13a = *Graphis duplicata* Ach.
schroederi Zahlbr., Group 8: 6b
scripta (L.) Ach., Group 4: 14a, Group 4: 35a
scripta var. *candida* Zahlbr. (*Graphis*) [nom. inval.], Group 4: 30b = *Graphis supracola* A. W. Archer
semiaperta Müll. Arg. (*Graphis*), Group 10: 5a = *Graphis aperiens* Müll. Arg.
seminuda Müll. Arg., Group 8: 26a
seminuda var. *sublaevis* Müll. Arg. (*Graphis*), Group 8: 26a = *Graphis seminuda* Müll. Arg.
semirigida (Müll. Arg.) Lücking, Group 14: 4a
serpens Fée (*Graphis*), Group 8: 18b = *Graphis rhizocola* (Fée) Lücking & Chaves
setchwanensis Zahlbr. (*Graphis*), Group 4: 40a = *Graphis furcata* Fée
sierraleonensis C. W. Dodge (*Graphina*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
sikkimensis Nagarkar & Patw. (*Graphis*), Group 13: 21b = *Graphis proserpens* Vain.
simplex Vain. (*Graphis*), Group 5: 8a = *Graphis analoga* Nyl.
sitapurensis Makhija & Adaw., Group 4: 9a
sitiana Vain., Group 8: 50a
slendrae Hale ex Lücking, Group 17: 19a
sophistica Nyl. (*Graphis*), Group 3: 6b (Notes), Group 14: 9b = *Graphis platycarpa* Eschw.
sophistica Nyl. ex Cromb. (*Graphis*), Group 3: 6b = *Graphis britannica* Staiger
sophisticascens Nyl., Group 5: 23b

sorediosa Nagarkar & Patw., Group 15: 7a
sorsogona Vain., Group 7: 4a
spodoplaca Zahlbr. (*Graphis*), Group 8: 42a = *Graphis assimilis* Nyl.
stellata Cáceres & Lücking, Group 8: 48a
stenospora Müll. Arg. (*Graphis*), Group 4: 10b = *Graphis crassilabra* Müll. Arg.
stenospora var. deficiens A. W. Archer (*Graphis*), Group 4: 15b = *Graphis elongata* Zenker
stenotera Vain., Group 13: 9b
stictica Staiger (*Carbacanthographis*), Group 8: 32b (Notes)
stipitata A. W. Archer, Group 4: 16a
streblocarpa (Bél.) Nyl., Group 3: 4a, Group 5: 13a
streblocarpa Bél. (*Opegrapha*), Group 3: 4a ≡ *Graphis streblocarpa* (Bél.) Nyl.
streblocarpa var. *pauperior* Vain. (*Graphis*), Group 3: 4a = *Graphis streblocarpa* (Bél.) Nyl.
streimannii A. W. Archer, Group 6: 4a
striatula (Ach.) Spreng., Group 15: 12a, Group 17: 20a (Notes)
striatula Ach. (*Opegrapha*), Group 15: 12a = *Graphis striatula* (Ach.) Spreng.
striatula var. *substellaris* Redinger (*Graphis*), Group 15: 12a = *Graphis striatula* (Ach.) Spreng.
subalbostriata Lücking, Group 13: 13a
subalbotecta Staiger (*Carbacanthographis*), Group 9: 2a (Notes), Group 9: 6b (Notes)
subamylacea Zahlbr., Group 8: 34a
subangustata Vain. (*Graphis*), Group 17: 14a = *Graphis angustata* Eschw.
subasahinae Nagarkar & Patw., Group 4: 22b
subassimilis Müll. Arg., Group 8: 6a
subcelata A. W. Archer, Group 8: 28b
subchrysocarpa Lücking, Group 1: 8a
subcinerea Staiger (*Graphis*) [nom. inval.], Group 20: 5a = *Graphis phaeospora* Vain.
subcontorta (Müll. Arg.) Lücking & Chaves, Group 3: 7b
subcontorta Müll. Arg. (*Graphina*), Group 3: 7b ≡ *Graphis subcontorta* (Müll. Arg.) Lücking & Chaves
subcurva Zenker (*Graphis*), Group 17: 14a (Notes)
subdisserpens Nyl., Group 8: 25a
subducta Vain., Group 14: 7a
subdura M. Nakan. (*Graphis*), Group 8: 14a (Notes), Group 8: 22a (Notes)
subelegans Nyl. (*Graphis*), Group 13: 19a = *Graphis endoxantha* Nyl.
subelmeri (A. W. Archer) A. W. Archer, Group 9: 21a
subflexibilis Lücking & Chaves, Group 11: 1a, Group 20: 1a
subglauconigra Nagarkar & Patw. (*Graphis*), Group 15: 13b = *Graphis tenella* Ach.
subhiascens (Müll. Arg.) Lücking, Group 5: 19b
subimmersa (Fée) A. Massal., Group 8: 24a
subintegra Redinger (*Graphis*), Group 8: 27a = *Graphis flavens* Müll. Arg.
subintermedians Hale ex Lücking, Group 16: 2a
submarginata Lücking, Group 6: 12a
subnitida Nyl. (*Graphis*), Group 3: 9b (Notes)
subpulicaris Zahlbr. (*Graphina*), Group 9: 8b = *Graphis cleistoblephara* Nyl.
subradiata (Nyl.) Lücking, Group 18: 18b
subregularis A. W. Archer, Group 6: 10a
subruiziana Sipman, Chaves & Lücking, Group 9: 26a
subserpens Staiger, Group 10: 11b
subserpentina Nyl., Group 5: 5a
substriatula (Nyl.) Staiger (*Glyphis*), Group 18: 13a (Notes)
subtartarea Müll. Arg. (*Graphina*), Group 7: 3b = *Graphis insulana* (Müll. Arg.) Lücking
subtecta (Nyl.) Lücking, Group 9: 31a
subtenella Müll. Arg. (*Graphis*), Group 13: 20a = *Graphis chlorotica* A. Massal.
subtracta Nyl., Group 17: 5a
subturgidula Lücking & Sipman, Group 9: 4a
subvelata Stirt., Group 7: 6a
subvernicosa Lücking, Group 9: 16a
subvestita Vain. (*Graphis*), Group 18: 12a = *Graphis macella* Kremp.
subvirginea Nyl., Group 8: 52a
subvirginea var. *rhizophorearum* Vain. (*Graphis*), Group 4: 34b = *Graphis dendrogramma* Nyl.
subvirginea var. *streblicola* Vain. (*Graphis*), Group 4: 34b = *Graphis dendrogramma* Nyl.
subvittata Adaw. & Makhija, Group 13: 6b
sulcata Fink (*Graphis*), Group 14: 5b = *Graphis perstriatula* Nyl.
sulcata Müll. Arg. (*Phaeographis*), Group 15: 13b = *Graphis tenella* Ach.
sulphurella (Zahlbr.) Lücking, Group 3: 8a
sundarbanensis Jagadesh Ram & G. P. Sinha, Group 4: 34a
superans Müll. Arg., Group 10: 10a
supernata Vain. (*Graphis*), Group 17: 15a = *Graphis longula* Kremp.
supertecta Müll. Arg., Group 13: 14b
supracola A. W. Archer, Group 4: 30b
symplecta Nyl., Group 14: 11a
symplocorum Zahlbr. (*Graphina*), Group 5: 10a = *Graphis renschiana* (Müll. Arg.) Stizenb.
syzygii Aptroot, Group 19: 1a
tapetica Zahlbr. (*Graphis*), Group 8: 42b = *Graphis intricata* Fée
tenella Ach., Group 15: 13b
tenella var. *elongata* Zahlbr. (*Graphis*), Group 4: 28a = *Graphis filiformis* Adaw. & Makhija
tenella var. *jatrophae* Vain. (*Graphis*), Group 6: 8b = *Graphis cincta* (Pers.) Aptroot
tenellula Vain. (*Graphis*), Group 6: 8b, Group 8: 42a (Notes) = *Graphis cincta* (Pers.) Aptroot
tenellula var. *eutypodes* Vain. (*Graphis*) [nom. inval.], Group 6: 8b = *Graphis cincta* (Pers.) Aptroot
tenoriensis Lücking & Chaves, Group 14: 9a
tenuescens var. *subimmersa* Redinger (*Graphis*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
tenuirima (Shirley) A. W. Archer, Group 5: 23a
tenuis Vain. (*Graphis*), Group 4: 13a = *Graphis hossei* Vain.
tetralocularis C. Bock & Hauck, Group 4: 32a
theae Zahlbr. (*Graphis*), Group 13: 9a = *Graphis vittata* Müll. Arg.

tjibodensis Zahlbr. (*Graphina*), Group 3: 4b = *Graphis japonica* (Müll. Arg.) A. W. Archer & Lücking
tonglonensis Vain. (*Graphis*), Group 8: 5a = *Graphis rustica* Kremp.
treubii Zahlbr. (*Graphis*), Group 13: 9a = *Graphis vittata* Müll. Arg.
trichospora Vain., Group 13: 4a, Group 15: 6b (Notes), Group 17: 6b (Notes)
triphora Nyl., Group 5: 16a
triphoroides (M. Wirth & Hale) Lücking (*Carbacanthographis*), Group 5: 12b (Notes), Group 5: 13b (Notes)
tsunodae Zahlbr., Group 10: 8b (Notes), Group 13: 19b
tuberculifera Müll. Arg. (*Graphina*), Group 18: 8a = *Graphis acharii* Fée
tumidula (Fée) Spreng., Group 8: 16a
tumidula Fée (*Opegrapha*), Group 8: 16a = *Graphis tumidula* (Fée) Spreng.
tumidulella Fink (*Graphis*), Group 17: 16b = *Graphis glauconigra* Vain.
turgidula Müll. Arg. (*Graphis*), Group 8: 5a = *Graphis rustica* Kremp.
turgidula var. *norstictica* A. W. Archer (*Graphis*), Group 8: 8a = *Graphis marginata* Raddi
urandrae Vain., Group 4: 38b
uruguayensis Lücking, Group 4: 15a
valparaiensis Adaw. & Makhija, Group 2: 2a
verminosa Müll. Arg., Group 13: 4a (Notes), Group 15: 6b, Group 17: 6b (Notes)
vernicosa Fée (*Opegrapha*), Group 9: 16a ≡ *Graphis subvernicosa* Lücking
vernicosa Nyl. (*Graphis*) [homonym], Group 9: 16a
verruciformis Adaw. & Makhija (*Graphis*), Group 8: 42a = *Graphis assimilis* Nyl.
verrucoserpens Lücking, Group 13: 21a
verruculina Zahlbr. (*Graphina*), Group 3: 4b = *Graphis japonica* (Müll. Arg.) A. W. Archer & Lücking
vestita Fée (*Graphis*) [nom. illeg.], Group 5: 6a, Group 17: 13a
vestita Fr., Group 5: 6a, Group 17: 13a
vestita M. Nakan., Kashiw. & K. H. Moon (*Graphina*), Group 5: 6a ≡ *Graphis rongklaensis* Sutjaritturakan
vestitoides (Fink) Staiger, Group 18: 2a
vicarians Vain. (*Graphis*), Group 2: 14a (Notes)
vinosa Müll. Arg. (*Graphis*), Group 4: 6a = *Graphis erythrocardia* Müll. Arg.
virens Müll. Arg. (*Graphis*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
virens var. *saxicola* Redinger (*Graphis*), Group 17: 14b = *Graphis calcea* (Fée) A. Massal.
virescens Müll. Arg. (*Graphis*), Group 8: 44a = *Graphis conferta* Zenker
vittata Müll. Arg., Group 13: 9a
xanthospora Müll. Arg., Group 2: 12b
xylophaga (R. C. Harris) Lendemer, Group 5: 21a
xylophaga (R. C. Harris) Lücking (*Graphis*) [comb. illeg.], Group 5: 21a
yaucoensis Fink (*Graphis*), Group 4: 26b = *Graphis. caesiella* Vain
zonatula Zahlbr. (*Graphis*), Group 4: 9b = *Graphis longiramea* Müll. Arg.

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