

Notes on the Genera *Graphina* and *Graphis* (Graphidaceae) in Thailand

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Abstract Ten species of the genera *Graphina* and *Graphis* in the lichen family Graphidaceae are reported from Thailand, of which *Graphina vestita* M.Nakan. Kashiw. & K.H.Moon is new to science. Eight species, *Graphina dimorphodes* (Nyl.) Zahlbr., *G. erythrella* (Mont. et v.d. Bosch) Zahlbr., *G. glaucorufa* (Vain.) Zahlbr., *G. inabensis* (Vain.) Zahlbr., *G. irosina* (Vain.) Zahlbr., *G. perstriatula* (Nyl.) Zahlbr., *G. subserpentina* (Nyl.) Müll.Arg. and *Graphis aphanes* Mont. et v.d. Bosch are reported for the first time for Thailand.

Key words: *Graphina*, *Graphis*, *Graphina vestita*, new species, lichen, Thailand

The genera *Graphis* and *Graphina* are crustose lichens in the family Graphidaceae. Although they are widely distributed in the world, especially from tropical and subtropical areas, only 14 species have been reported from Thailand (Vainio 1907, 1909, 1921; Zahlbruckner 1924; Wang-Yang & Lai 1973).

During their lichenological investigation in Thailand in 1998 under the Collection Building and Natural History Studies in Asia and the Pacific Rim project supported by the National Science Museum, Tokyo, Kashiwadani and Moon collected 19 specimens of the genera. Taxonomic studies of them determined eight species of *Graphina* and one species of *Graphis* which have never been reported from Thailand.

Material and Method

The present study is based on 19 specimens of the genera *Graphina* and *Graphis* collected by Kashiwadani and Moon during their field survey for lichens in Thailand in 1998. Collections were made in Phuhinlongkla National Park, Prov. Pisanuklok and Queen Sirikit Botanic Garden, Prov. Chiang Mai. Specimens reported in the present paper are kept in the herbarium of the National Science Museum and partly in the herbarium of the Ramkhamhaeng University, Bangkok. Chemical substances

were studied by means of thin-layer chromatography (Culberson & Johnson 1982) and HPLC. Sections of apothecia and thalli were cut by hand-razor and mounted in GAW or lactophenol cotton-blue solutions.

Results

Key to the species of *Graphina* and *Graphis* in Thailand

1. Thallus not isidiate 2
2. Ascocarps with non-carbonized exciples 3
 3. Ascocarps fissurine, labia absent 4
 4. Spores transversely septate; P+orange-yellow containing stictic acid.
 *Graphis aphanes* Mont. et v.d. Bosch
 4. Spores submuriform; P—containing no chemical substance
 *Graphina inabensis* (Vain.) Zahlbr.
 3. Ascocarps not-fissurine, labia usually prominent 5
 5. Disc open, epruinose, labia not-striate; P+norstictic acid present
 *Graphina erythrella* (Mont. & v.d. Bosch) Zahlbr.
 5. Disc closed; labia more or less striate 6
 6. Labia with dark brown pigments on the top; containing norstictic acid
 *Graphina glaucorufa* (Vain.) Zahlbr.
 6. Labia without brown pigment on the top; containing stictic acid
 *Graphina irosina* (Vain.) Zahlbr.
2. Ascocarps with carbonized exciples 7
 7. Exciples striate, without thalline margin
 *Graphina perstriatula* (Nyl.) Zahlbr.
 7. Exciple non-striate, totally or partly covered with thalline margin 8
 8. Ascocarps flexuous, branched; spores submuriform, less than 50 μm long
 *Graphina subserpentina* (Nyl.) Müll.Arg.
 8. Ascocarps unbranched; spores muriform, up to 170 μm long
 *Graphina vestita* M.Nakan., Kashiw. & K.H.Moon
1. Thallus isidiate *Graphina dimorphodes* (Nyl.) Zahlbr.

1) *Graphina dimorphodes* (Nyl.) Zahlbr., Cat. Lich. Univ. 2: 404. 1924.

Basionym. *Graphis dimorphodes* Nyl. Trans. Linn. Soc. London, 27: 176, 1869. Ceylon, E. Almquist s.n., H-NYL 7811—holotype in H!

The specimen from the present area has cylindrical isidia (1–1.2 mm in diameter and 1–1.6 mm in length) on the thallus, a non-carbonized thin exciple (5–10 μm thick) with yellowish pigments on the terminals, colorless muriform spores, 20–24 \times 8–10 μm , and produces norstictic acid. Although the type specimen of *G. dimorphodes* has immature smaller spores (8–17 \times 5–8 μm), other diagnostic characters coincide well with the present species.

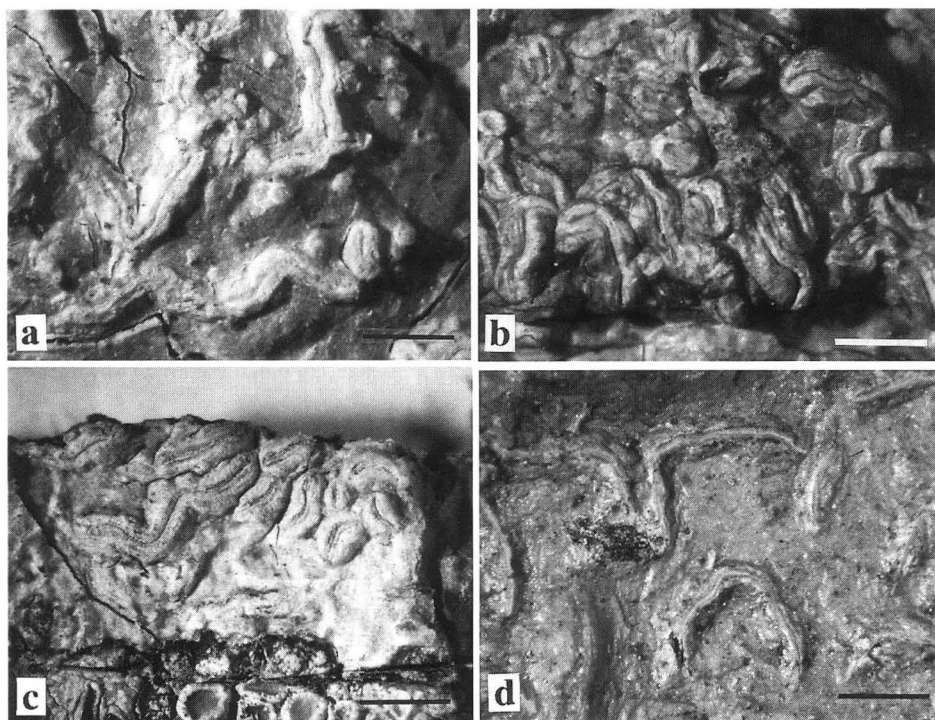


Fig. 1. a) *Graphina dimorphodes* (Nyl.) Zahlbr., b) *Graphina erythrella* (Mont. & v.d. Bosch) Zahlbr., c) *Graphina glaucorufa* (Vain.) Zahlbr., d) *Graphina inabensis* (Vain.) Zahlbr. Scale bar=1 mm.

This is the only isidiate species of the genus *Graphina* in Eastern Asia. It might be confused with *Phaeographina isidiosa* (Vain.) Zahlbr., an isidiate species reported from the Philippines. However, it can be easily distinguished from the latter by the colorless spores. New to Thailand.

Specimen examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Trail to Lan Hinpum, Phuhinlongkla National Park (17°N, 101°E), on bark of *Podocarpus*, alt. 1250–1350 m, 23 February 1998, K. H. Moon (no. 4068) & H. Kashiwadani.

2) *Graphina erythrella* (Mont. & v.d. Bosch) Zahlbr. Cat. Lich. Univ. 2: 405. 1924.

Basionym. *Ustalia erythrella* Mont. & v.d.Bosch in Jungh., Plant. Junghuhn., fasc. 47: 478, 1855. Type collection. Java, Teysm s.n.-holotype in L!

The specimen from the present area has the following diagnostic characters: thallus greenish-gray to off-white, thick, continuous; ascocarps raised, more or less undulate, simple or rarely branched, covered by a prominent thalline margin nearly to the top of the exciples, 1–3 mm long, 0.3–0.4 mm wide; exciple non-carbonized, pale orange- yellow at the base, labia convergent; hymenium 90–110 μm high. Spores not

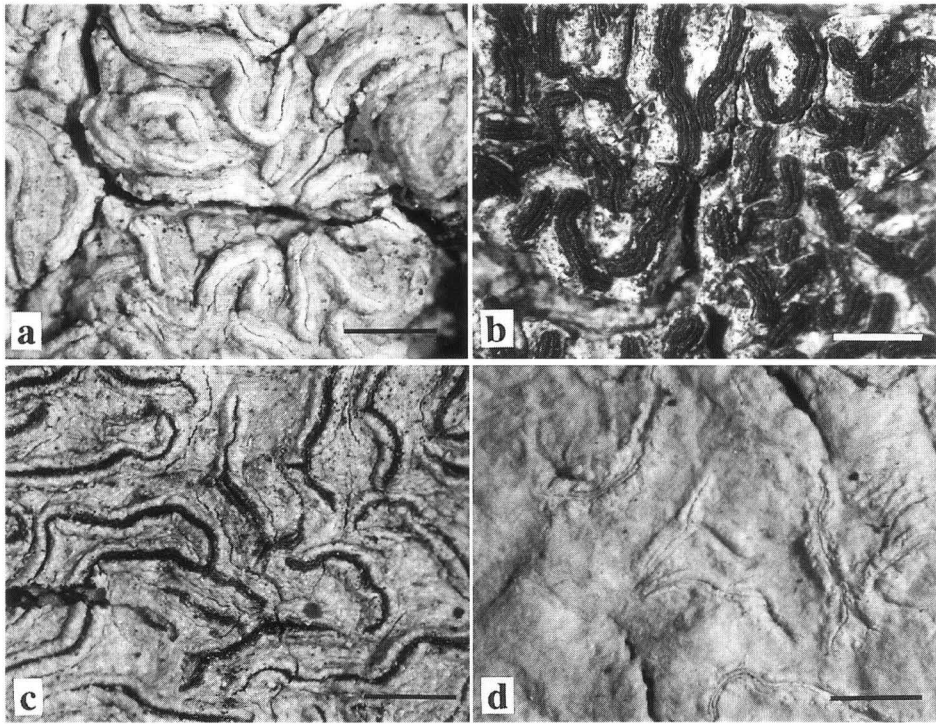


Fig. 2. a) *Graphina irosina* (Vain.) Zahlbr., b) *Graphina perstriatula* (Nyl.) Zahlbr., c) *Graphina subserpentina* (Nyl.) Müll. Arg., d) *Graphis aphanes* Mont. Scale bar = 1 mm.

seen. Norstictic acid present.

Although the examined specimen has no spores in the asci, the general characteristic features coincides well with the type of *G. erythrella*. This species very much resembles *G. dimorphodes*, from which it can be easily distinguished by the absence of isidia. New to Thailand.

Specimen examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Trail to Lan Hinpum, Phuhinlongkla, Phuhinlongkla National Park (17°N, 101°E), on bark, alt. 1250–1350 m, 23 February 1998, K. H. Moon (no. 2190) & H. Kashiwadani.

3) *Graphina glaucorufa* (Vain.) Zahlbr. Cat. Lich. Univ. 2: 407. 1924.

Basionym. *Graphis glaucorufa* Vain. Annal. Soc. Zool.-Bot. Fennic., 1: 51, 1921. Type collection. Siam (Thailand), Mt Doi Sutep, 1675 m, 1904, C.C. Hosseus s.n. TUR-V 27213-holotype!

Since Vainio (1921) described this species under the name of *Graphis glaucorufa*, on the basis of a collection made from Mt Doi Sutep near Chiang Mai, it has never been reported. In the present survey, this species was found at one locality in



Fig. 3. Holotype of *Graphina vestita* M. Nakan., Kashiw. & K. H. Moon. Scale bar=1 mm.

the Phuhinlongkla National Park. Although the collection from the present area is very small (ca 1×1 cm), it has the following characteristic features: thallus off-white; ascocarps concolorous with thallus, prominent, covered with thallus; disc pruinose with white pruina; labia pale yellowish-orange at the tips; exciple non-carbonized; spores muriform, 30–35×8–10 μm (mature spores not seen). No chemical substance was detected by TLC.

Specimen examined. Thailand: Prov. Pisanuklok. Nakorn Thai District: Around Phuhinlongkla visitor center (old Community Party Political Ministry School), Phuhinlongkla National Park (17°N, 101°E), on bark of *Podocarpus* sp., alt. 1250 m, 24 February 1998, K. H. Moon (2286d) & H. Kashiwadani.

4) *Graphina inabensis* (Vain.) Zahlbr. Cat. Lich. Univ. 2: 409. 1923.

Basionym. *Graphis inabensis* Vain. Type collection: Japan, Honshu, Prov. Inaba, A. Yasuda 47(TUR-V 27359!—holotype; isotype in TNS). Chemistry: no lichen substance detected by TLC.

Graphina inabensis might be confused with *G. glaucorufa*, since they both have non-carbonized exciples and ascospores less than 30 μm in length. However, ascocarps of *G. inabensis* are always closed and have no striations on the labia. In contrast, those of *G. glaucorufa* are distinctly open and have pruinose discs. In addition, the labia are more or less sulcate near the tops in *G. glaucorufa*.

G. inabensis has been reported only from Japan (Nakanishi 1966). This is the first record for this species outside Japan. One collection from Formosa collected by Kurokawa is also identified with this species. The distribution is now extended south

to Thailand.

Specimens examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Ca. 4 km E of Phuhinlongkla visitor center (old Community Party Political Ministry School.), Phuhinlongkla National Park, on bark (17°N, 101°E), alt. 1250–1350 m, 24 February, 1998, K. H. Moon (2233a) & H. Kashiwadani. Thailand. Prov. Pisanuklok. Nakorn Thai District: Trail to Lan Hinpum, Phuhinlongkla, Phuhinlongkla National Park (17°N, 101°E), on bark, alt. 1250–1350 m, 23 February 1998, K. H. Moon (2418) & H. Kashiwadani.

Formosa. Pref. Taitung: Chinsueiin Pass, on bark, alt. 1200 m, S. Kurokawa 2963 (TNS).

5) *Graphina irosina* (Vain.) Zahlbr. Cat. Lich. Univ. 2: 412. 1924.

Basionym. *Graphis irosina* Vain. Annal. Acad. Scient. Fennic., ser.A, 15: 213, 1921. Type collection. Philippines, Sorsogon, Irosin, A.D.E. Elmer 15100 (TUR-V 27220-holotype). Chemistry: stictic acid.

The present species is quite similar to *G. albidolivens* (Vain.) Zahlbr. (Type collection. Philippines, Luzon, A. D. E. Elmer 15029, TUR-V 27306-lectotype designated here). *G. irosina*, however, can be separated from the latter by spore size; the spores of *G. irosina* are 27–36×12–16 μm, whereas those of *G. albidolivens* are 70–140×16–38 μm).

Specimen examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Trail to Lan Hinpum, Phuhinlongkla, Phuhinlongkla National Park (17°N, 101°E), on bark, alt. 1250–1350 m, February 23, 1998, K. H. Moon (2193) & H. Kashiwadani.

6) *Graphina perstriatula* (Nyl.) Zahlbr. Cat. Lich. Univ. 2: 418. 1924.

Basionym: *Graphis perstriatula* Nyl., Bull. Soc. Linn. Normand., ser. 2, 7: 170. 1873.

Type collection. India. Andaman Island, S. Kurz 1867, H-Nyl 7779-holotype in H! Chemistry: norstictic acid (major), connorstictic acid (minor) and stictic acid(minor).

Since Nylander (1873) described this species as *Graphis perstiratula* Nyl. from the Andaman Islands, it has never been reported. The specimen from the present area was collected on bark of *Podocarpus* at alt. ca. 1250 m. Specimens from the present area have the following diagnostic features which coincide well with the type specimen of *G. perstriatula*: thallus whitish-gray; ascocarps simple to flexuous, 10–15 mm long; labia prominent, striations very clear, covered by thallus only at the base; exciple black above, yellowish-brown laterally and basely; ascospores colorless, muriform, 25–36×12–18 μm; containing norstictic acid as major chemical substance.

The present species is very similar to *G. semirigida* Müll.Arg. (Type collection: India, Manipur, G. Watt 83-holotype in BM!), an endemic species of India, from which it can be distinguished by the smaller spores (25–36×12–18 μm) instead of

larger spores (72–88×20–26 μm). In external appearance it resembles *Graphis theae* Zahlbr., from which it can be easily distinguished by the muriform spores.

Specimen examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Around Phuhinlongkla visitor center (old Community Party Political Ministry School), Phuhinlongkla National Park (17°N, 101°E), on bark of *Podocarpus* sp., alt. 1250 m, 24 February 1998, K. H. Moon (2286b) & H. Kashiwadani.

7) *Graphina subserpentina* (Nyl.) Müll. Arg. Bull. Soc. Bot. Belgique, 32: 152. 1893

Basionym. *Graphis subserpentina* Nyl. Acta Soc. Sci. Fenn., 7: 465. 1863. Type collection: Ceylon, H. Hooker, NH 8012-holotype in H!). Chemistry: norstictic acid.

Graphina insulana Müll.Arg., In Engler, Bot. Jahrb. 4: 56. 1883. Type collection: Fiji, Vitileva 30-holotype in G, syn. nov. Chemistry: norstictic acid.

Müller Argoviensis (1883) described *G. insulana* from Fiji. The type specimen in G has well branched ascocarps which are more or less immersed in the thallus, labia entire and convergent, exciple carbonized laterally, open at the base, spores one per ascus, muriform, 52–83×18–20 μm , and produces norstictic acid. These characters coincide well with the type of *Graphis subserpentina* and *Graphina insulana* was reduced to a synonym of *Graphis subserpentina*.

G. subserpentina is widely distributed in south-east Asia and the Pacific Islands, having been reported from India, Sri Lanka, Java, Philippines, New Caledonia and Fiji (Awasthi 1991, Nylander 1863, Redinger 1933, Vainio 1921). The distribution now includes Thailand, where it grows on bark of *Thea* at alt. ca. 700 m.

Specimen examined. Thailand. Prov. Chiang Mai. Mae Rim District: Queen Sirikit Botanic Garden, on bark of *Thea* sp., alt. ca. 700 m, 3 March 1998, K. H. Moon (2315) & H. Kashiwadani.

8) *Graphina vestita* M.Nakan., Kashiw. & K.H.Moon, sp. nov.

Similis *Graphina amicta* sed differt ascocarpiis tenuibus, sporis unicis, majoribus, et acidiiis norsticticis continentis.

Thallus corticolous, continuous, smooth, whitish-gray, subnitid. Apothecia prominent, simple, unbranched, concolorous with the thallus, up to 2 mm long, up to 0.5 mm wide; Labia covered by a thalline margin, convergent; exciple dimidiate, carbonized laterally; hymenium 240 μm high, non-carbonized, surface with no pruina. Spores colorless, asci-1spored, spores ellipsoid, muriform, colorless, 105–170×30–45 μm .

Holotype. Thailand, Prov. Chiang Mai, Mae Rim District: Queen Sirikit Botanic Garden, on bark of *Castanopsis* sp., alt. ca. 860 m, 3 March 1998, K. H. Moon (2295) and H. Kashiwadani—holotype in TNS; isotype in Ramkhamhaeng University, Bangkok, Thailand (RAMK). Chemistry: norstictic acid (major), constictic acid (minor) and stictic acid (minor).

G. vestita resembles *G. amicta* (Nyl.) Zahlbr., a species reported from the Bonin Islands, Japan. However, it can be clearly distinguished by the larger spores (up to 170 μm in length). It might be confused with *G. illinata* (Eschw.) Wirth, a species reported from Dominica and Brazil (Wirth & Hale 1978), since they both have similar ascocarps covered by the thallus, and larger muriform spores. However, it can be distinguished from the latter by the dimidiate exciple and by the constant production of norstictic acid. In the latter species, the exciples are carbonized laterally and basally. In addition, *G. illinata* produces no chemical substance (Wirth & Hale 1978). *G. vestita* also resembles *G. frumentaria* (Fée) Müll.Arg., a species described from Peru, which differs in having convergent labia and smaller spores (less than 60 μm in length), and in lacking chemical substances.

9) *Graphis aphanes* Mont. et v.d. Bosch, Jungh., Plant. Junghuhn., fasc. 4, 474, 1855.

Graphis glaucocinerea Vain. Hedwigia, 46: 178, 1907 (Type collection: Siam, J. Schmidt no. VIII—holotype in TUR!, isotype in FH!), syn. nov.

In Thailand, this species has been known under the name of *G. glaucocinerea* Vain. The type specimen of *G. glaucocinerea* has buff thalli and light-colored lirellae with subsulcate margins to a colorless exciple. The asci have 8-spored with colorless spores with 17–20 locules (72–80 \times 7–9 μm in size) and contain stictic acid as a chemical substance. These characters coincide well with the type of *Graphis aphanes* morphologically and anatomically. Therefore, *G. glaucocinerea* can be reduced to a synonym of *G. aphanes*.

The present species might be confused with *G. oshioi* M.Nakan., an endemic species of Japan (Nakanishi, 1966), since they have similar apothecia and the thallus show orange-red reaction with P. However, it is clearly distinguished from the latter by the larger spores (72–80 \times 7–9 μm) and in produces stictic acid. *G. oshioi* has smaller spores (20–30 \times 7–9 μm) and produces norstictic acid.

G. aphanes has been reported from Asia and the distribution includes Java (type locality), India (Awasthi 1991) and Japan (Yaeyama Islands and Bonin Islands; Nakanishi 1981; Kashiwadani & Nakanishi 1978). This is the second report for this species in the present area where it grows on bark at alt. between 1250 and 1350 m.

Specimen examined. Thailand. Prov. Pisanuklok. Nakorn Thai District: Ca. 4 km E of Phuwinlongkla visitor center (old Community Party Political Ministry School.), Phuwinlongkla National Park, on bark (17°N, 101°E), alt. 1250–1350 m, 24 February 1998, K. H. Moon (2233b) & H. Kashiwadani.

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References

- Awasthi, D. D., 1991. A key to the microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenologica* **40**: 1–337.
- Culberson, C. F. and A. Johnson, 1982. Substitution of methyl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *J. Chromat.* **238**: 483–487.
- Kashiwadani H. and M. Nakanishi, 1978. A note on rare species of the Graphidaceae (Lichens) from the Bonin Islands. *Mem. Natn. Sci. Mus., Tokyo* (11): 21–25.
- Müller Argoviensis, J. 1883. Die auf der Expedition der Gazelle von Dr. Naumann gesammelten Flechten. *Bot. Jahrb.* **4**: 56–57.
- Nakanishi, M., 1966. Taxonomical studies on the family Graphidaceae of Japan. *J. Sci. Hiroshima Univ., Ser. B, Div. 2*, **11**: 51–126.
- Nakanishi, M., 1981. Notes on lichen species of the Yaeyama Island, Japan. *Hikobia Suppl.* **1**: 211–220.
- Nylander, W., 1863. Lichenographia Novo-Granatensis Prodrromus. *Acta. Soc. Scient. Fennic.* **7**: 465–466.
- Nylander, W., 1873. Lichenes insularum Andaman. Bull. Soc. Linn. Norman., ser. 2. vol. 7, pp. 176.
- Redinger, K., 1933. Graphidineen von Celebes und Java. *Ann. Mycol.* **31**: 168–180.
- Vainio, E. A., 1907. Lichenes novi rarioresque IV. *Hedwigia* **46**: 168–181.
- Vainio, E. A., 1909. Lichenes in J.Schmidt, Flora of Koh Chang, Contributions to the knowledge of the vegetation in the Gulf of Siam. Part. IX. *Bot. Tidskr. Köhenh.* **29**: 104–151.
- Vainio, E. A., 1921. Lichenes in summo monte Doi Sutep (circ. 1675 ms.m) in Siam Boreali anno 1904 a Dre C.C. Hosseo collecti. *Annal. Soc. Zool-Bot. Fennic.* **1**: 33–55.
- Wang-Yang J. R. and Lai M. J. 1973. A checklist of the lichens of Taiwan. *Taiwania* **18**(1): 83–104.
- Wirth, M. & M. E. Hale, 1978. Morden-Smithsonian expedition to Dominica: the lichens (Graphidaceae). *Smiths. Contr. Bot.* **40**: 1–53, 11 pls.
- Zahlbruckner, A., 1924. Catalogus Lichenes Universalis II, Leipzig.

