LICHEN GENERA *GLYPHIS, SARCOGRAPHA* AND *SARCOGRAPHINA** FROM INDIA

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Abstract

The paper deals with the morpho-taxonomic study of three species of *Glyphis* Ach., four species of *Sarcographa* Fée and one species of *Sarcographina* Mull. Arg. from India.

Introduction

Zahlbruckner (1926) placed the genera *Glyphis* Ach., *Sarcographa* Fée and *Sarcographina* Mull. Arg. in the family Chsodectonaceae. Later, Nakanishi (1966), and Eriksson and Hawksworth (1987) have placed the three genera in Graphidaceae, a concept which has been currently accepted by the lichenologists.

Awasthi (1965), and Singh and Awasthi (1979) have reported 3 species of *Glyphis*, 8 species of *Sarcographa* and 2 species of *Sarcographina* from Indian subcontinent. *Glyphis cicatricosa* Ach. is reported from Calcutta (India) and Sri Lanka. *G. duriuscula* Stirton from Assam, *G. favulosa* Ach. from Calcutta and Sri Lanka, *Sarcographa maculosa* (Stirton) Zahlbr. from Assam, while the remaining species, viz., *Sarcogrpha feei* (Meissn.) Mull. Arg., *S. heteroclita* (Mont.) Zahlbr. (=*S. leprieurii* (Mont.) Mull. Arg.), *S. labyrinthica* (Ach.) Mull. Arg., *S. subtorquescens* (Nyl.) Zahlbr., *S. subtricosa* (Leight.) Mull. Arg., *S. tricosa* (Ach.) Mull. Arg. *Sarcographina glyphiza* (Nyl.) K. Singh and Awasthi and *S. torquescens* (Nyl.) Zahlbr. are reported from Sri Lanka only.

Material and methods

The investigations presented in this paper are primarily based on the specimens preserved at Botany Department, Lucknow University (LWU) and personal collections of D.D. Awasthi (Awas.). In addition specimens of National Botanical Research Institute, Lucknow (LWG) and Glasgow Museums and Art Gallaries, Glasgow (GL-AM) have also been borrowed.

The specimens were studied with respect to their morphology, anatomy and chemistry and identified up to specific level with the help of type or authentic materials and requisite literature. The line diagrams are given to illustrate the tranasactions of lirellae (apothecia) and spores (Text-figs. 1-6).

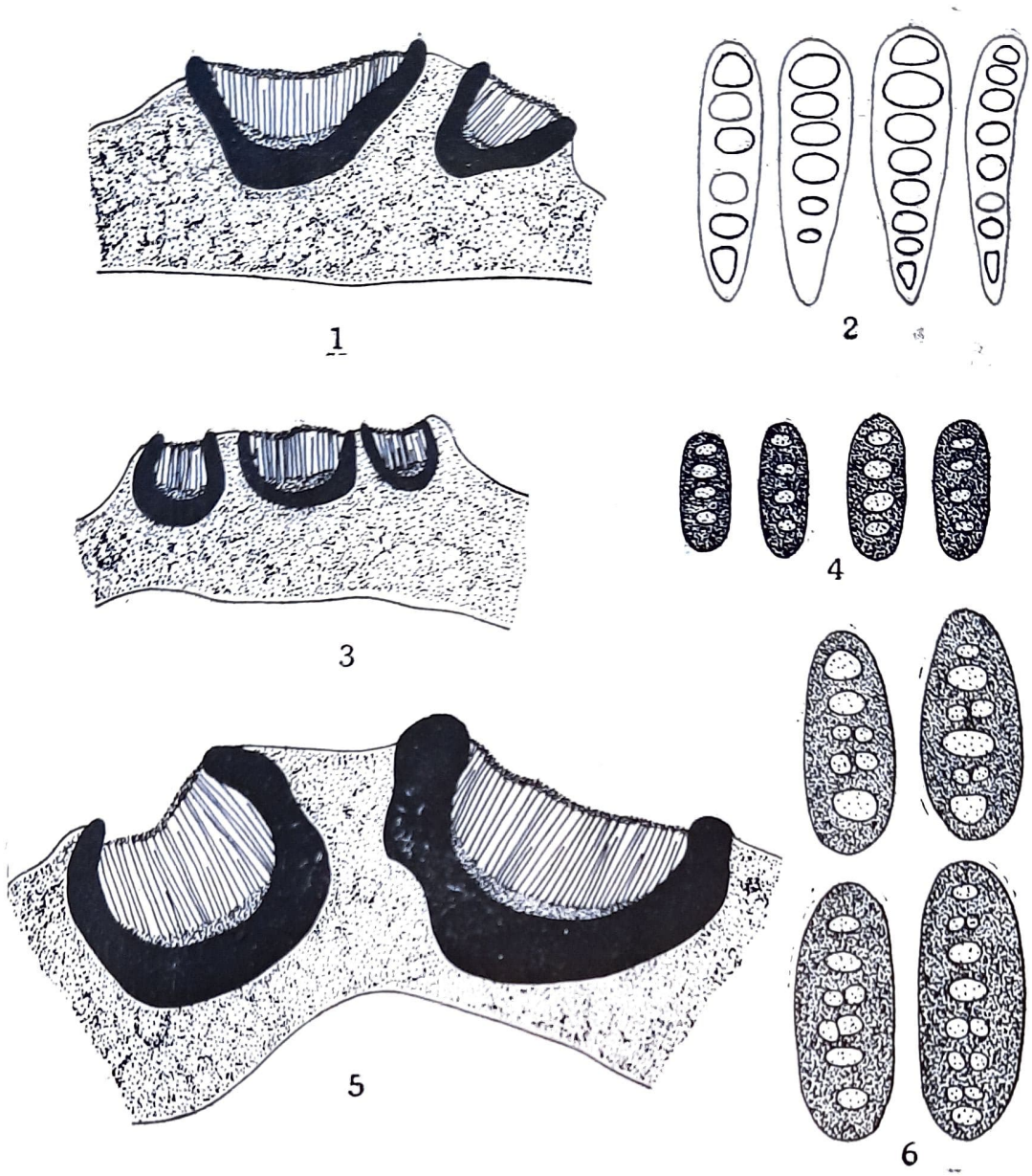
TLC was done according to the technique of Walker and James (1980) in solvent A. Silica gel G coated glass plates were prepared in the laboratory, and for confirmation of lichen substances precoated aluminium plates were used.

The genera of Graphidaceae are distinguished by the presence of lirellate apothecia. The three genera under investigation are characterised by crustose thallus, photobiont a *Trentipohlia*, apothecia lirellate, lirellae embedded in stroma, paraphyses simple, and they are distinct from other genera of Graphidaceae by the presence of stroma. The three genera are distinguished from each other by spore character as follows.

Key to the genera

1a. Spores colourless, transversely septate.. ..... *Glyphis*

*This is a part of work carried out under research project "Investigations on some microlichen genus of India" financed by the Council of Scientific and Industrial Research, New Delhi.



Text-figs. 1-6—Line diagrams of V. S. of lirellae, and spores. 1, 2. *Glyphis cicatricosa* Ach. Fig. 1. V. S. lirellae showing apothecia embedded in stroma, Fig. 2. Spores. Fig. 3,4 *Sarcographa labyrinthica* (Ach.) Mull. Arg.—3. V. S. lirellae showing apothecia embedded in stroma, 4. Spores. 5,6. *Sarcographina glyphiza* (Nyl.) K. Singh & Awasthi. Fig. 5. V. S. lirellae showing apothecia embedded in stroma, Fig. 6. spores.

1b. Spores brown.....2
2a. Spores transversely septate.....
.....*Sarcographa*
2b. Spores muriform.....*Sarcographina*

GLYPHIS ACH.
Syn. Lich. : 106 (1814).

Key to the species :

1a. Stroma black..... 3 *G. duriuscula*
1b. Stroma white to greyish-white, pruinose.....2
2a. Lirellae round to elongate, (0. 5) 0.5-1.5×0.25 (-0.5) mm, no lichen substance.....1 *G. cicatricosa*
2b. Lirellae linear-elongate, narrower, repeatedly branched and confluent, zeorin, usnic acid (?) and an undetermined grey-brown spot at Rf value 0.27.....2 *G. confluens*

1. *Glyphis cicatricosa* Ach.
Syn. Lich. : 107 (1814).
Type Collection: Guinea (Africa)-not seen.

Pl. 1, fig. 1; Text-figs. 1-2

Thallus crustose, corticolous, yellow to

yellowish-brown, smooth. Stroma white to greyish-white, pruinose, (0.5-) 1-4.5 × 1-1.5 mm, apothecia round, oblong effigurate to lirellate, (0.25-) 0.5-1.5 × 0.25 (-0.5) mm, brown with black margin. Exciple brown-black, carbonized, (10-) 30-60 μm thick, K-. Epithecium brown. Hymenium colourless, (80-) 100-120 (-160) μm high, I-. Hypothecium colourless, 30-40 μm thick. Asci clavate, 8-spored, 100-130 × 20-30 μm. Spores colourless, ellipsoid, (5-) 6-11 (-15)-loculed, (a14 μm,) 30-70 × 8-10, locules unequal in size, lens shaped. Paraphyses simple.

TLC: No lichen substance.

The species is characterised by greyish-white stroma, apothecia round, oblong or effigurate-lirellate, and spores (5-) 6-11 (-15)-loculed, (14-) 30-70 × 8-10 μm. The taxon is distributed in E. Himalayas, peninsular India and Andaman Islands, and tropical regions in the world.

The species is close to *G. confluens* but the latter has narrow, branched and confluent lirellae, and contains zeorin, usnic acid (?) and unknown grey-brown spot at Rf value 0.27.

Specimens examined:

India, Andaman and Nicobar Islands, S. Andaman, Mt. Harriat, alt. below 100 ft, 1961, Singh 67668, 67672 (LWG). Karnataka, Bangalore district, Bannergatta Hazam Kalu, on bark of tree, alt. ca. 980 m, 1979, Awasthi, Upreti & Misra 79.156 (LWU) Chikmagalur district, Dattatryapeeta, alt. ca. 1750 m, on bark of tree, 1979, Awasthi, Upreti and Misra 79.510 (LWU). Kerala, Mallapuram district, Vallikunnu, on *Vitaria*, 1975, Singh & Ranjan 102327, 102342 (LWG); Ernakulum, near Piravum road, Rly. Track side, on bark of tree, 1973, Singh 73.347 (LWU); Punalur, alt. 90 m, on rubber plant (*Hevea brasiliensis*), 1984, D. Awasthi & G. Awasthi 84.11 (LWU); Keezhayam, alt. ca. 90 m, on bark of *Albizia*, 1984, D. Awasthi & G. Awasthi 84.25 (LWU); same locality, on bark of 4-6 years old copiced shoots of *Eucalyptus*, 1984, D. Awasthi & G. Awasthi 84.39 (LWU); Idukki district, Munnar, Mattupatty, Indo-Swiss project area, alt. ca. 1600-1700 m, on bark of leguminous tree, 1985, Awasthi, Tewari & Mathur 85.177, 85.187 (LWU); Thenmallay Tea Estate area near Munnar, along road side, alt. ca. 1800 m, on bark of *Cinnamomum* tree, 1985, Awasthi, Tewari & Mathur 85. 271, 85.273 (LWU). Tamil Nadu, Palni Hills, on way to Thandikudi from Panniakudi, alt. ca. 1350 m, on bark of tree, 1970, Awasthi & Singh 70.482 (LWU); Kodaikanal proper, around the lake, alt. ca. 1950 m, on bark of tree, 1970, Singh 70.776 (LWU); Shembaganur, in pear orchards, alt. ca. 1800 m, on bark of pear trees, 1970, Singh 70.858 (LWU); Perumal to Palni road side, via short cut road, alt. 1350-1500 m, on bark of tree, 1970, Singh 70.972 (LWU); Perumalmalai area, on way to Perumal peak, alt. 1500-2250 m, on bark of tree, 1970, Singh 70.1064 70.1074 (LWU); on way from Perumalamalai to Oothu near Hill view, alt. ca. 1350 m, on bark of tree, 1970, Singh 70.1196 (LWU); 5 miles below Oothu, Volagiri, alt. ca. 1080 m, on bark of *Eucalyptus* tree, 1970, Singh 70.1235 (LWU); Nilgiri Hills, on way from Kilkotagiri to Konada, alt. ca. 1800 m, on bark of tree, 1971, Awasthi & Singh 71.4 (LWU); Mettupalayam road, Hill Grove station in Adderly Shola, on bark, 1971, Singh 71.838 (LWU); Kotagiri to Kodanad road, near Finger post, alt. ca. 1890 m, on bark of tree, 1971, Singh 71.945 (LWU). W. Bengal, Darjeeling district, Darjeeling-Pashok road-at about 7-8 miles from Darjeeling, alt. ca. 1800 m, on bark of tree, scarce, 1967, Awasthi & Agrawal 67.153 (LWU); Kalimpong division, Munsong *Cinchona* plantation, alt. ca. 1500 m, on bark of tree, 1967, Awasthi & Agrawal 67.296 A (LWU).

2. *Glyphis confluens* Zenk. apud Goebel et Kunze Pharmazeut. Waarekunde 1: 163 (1827-29). Type not seen.

Pl. 1, fig. 2

Thallus crustose, corticolous, yellowish-brown, smooth. Stroma greyish-white, pruinose, 1-7 × 1-2 mm. Apothecia lirellate, lirellae narrow, branched and confluent, black. Exciple black, 10-30 μm thick, K-. Epithecium brown. Hymenium colourless, ca. 100 μm high, I-. Hypothecium ca. 20 μm thick. Asci clavate, 8-spored, 50-60 (80) × 12-20 μm. Spores colourless, (5-) 7-9 (-13)-loculed, 26-42 (-66) × 8-10 μm. Paraphyses simple.

TLC: Zeorin, usnic acid (?) and an undetermined grey-brown spot at Rf value 0.27.

The species is distinguished by narrow, branched and confluent lirellae, spores (5-) 7-9 (-13)-loculed, 26-42 (-66) × 8-10 μm, and presence of above mentioned lichen substances. It is known from Kerala, Tamil Nadu and Andaman Islands, and is distributed in tropical regions of the world.

Specimens examined:

India, Andaman Islands, S. Andaman, Port Blair, on *Mangifera indica*, 1961, Singh 78856 (LWG). Karnataka, Bangalore district, Bannergatta Hazam Kalu, behind temple, alt. ca. 980 m, on bark of tree, 1979, Awasthi, Upreti & Misra 79.183 (LWU). Kerala, Idukki district, Mattupatty, near Indo-Swiss project area, alt. ca. 1600-1700 m, on bark of *Erythrina* tree, 1985, Awasthi, Tewari & Mathur 85.209 (LWU); Mallapuram district, Calicut University Campus, on bark of tree, 1979, Awasthi, Upreti & Misra 79.748, 79.815 (LWU); Quilon, Kundara, on *Macaranga indica*, 1975, Singh & Ranjan 102934 (LWG). Orissa, Cheriakuda island in Chilka lake, on bark of *Glycosmis pentaphylla*, 1948, Awasthi 256 (Awas.). Tamil Nadu, Palni Hills, Kodaikanal, Shembaganur, alt. 1800 m, on bark of tree, 1959, Foreau 4169 (Awas.); same locality, near Sacred Heart College, alt. ca. 1800 m, on bark of *Pyrus* tree, 1970, Awasthi & Singh 70.77 (LWU).

3. *Glyphis duriuscula* Stirton

Proc. Phil. Soc. Glasgow 13: 189. 1881 (1882).
Type collection: (India), Assam, leg. A. Watt (Holotype: GLAM).

Pl. 1, fig. 3

Thallus crustose, corticolous, yellowish, smooth, shiny. Stroma black, carbonaceous, round to irregular in shape, (1-) 2-6 mm across, apothecia lirellate, lirellae black, confluent. Asci 8-spored. Spores colourless, 6-10-loculed, 26-46 × 8-10 μm, locules not uniform. Paraphyses become free and appear as small threads when K is added.
TLC not done as the type material was too small.
The species is distinctive in its black, carbonaceous stroma, narrow, confluent lirellae and spores 6-10-loculed, 26-46 × 8-10 μm.
The taxon is known from the type collection only.

SARCOGRAPHA Fée

Essai Cryptog. Ecorc. Offic.: 35 (1824).

Key to the species:

1a. Lirellae covered by white pruinose mass, spores 4-6-loculed, 14-18 (-20) × 6-8 μm ..... 2 *S. labyrinthica*
1b. Lirellae not covered by white pruinose mass 2
2a. Spores 4-loculed, 14-18 × 6-8 μm..... 4 *S. medusulina*.....
2b. Spores 4-6-loculed, more than 18 μm long.....3
3a. Margin of lirellae smooth, spores 18-22 × 6-8 μm..... ..1 *S. intricans*
3b. Margin of lirellae crenulate, spores 20-26 × 6-8 μm.....3 *S. maculosa*

1. *Sarcographa intricans* (Nyl.) Mull. Arg. Flora 70: 77 (1887).
Graphis intricans Nyl., Acta Soc. Sci. Fenn. 7: 473 (1863).
Type collection: Bogota, leg. Lindig-not seen.

Pl. 1, fig. 4

Thallus crustose, corticolous, yellow-brown. Stroma yellowish-white, 2-7 × 1-3 mm, apothecia round to sometimes elongate lirellate, black, 0.2-0.5 × 0.1 mm. Exciple brown-black, complete, 18-32 μm thick at apical region (much thickened at base). Epithecium brown. Hymenium colourless, 70-92 μm high, I-. Hypothecium yellow, 14-18 μm thick. Asci cylindrico-clavate, 8-spored, 66-80 × 16-18 μm. Spores pale brown, 4-6-loculed, 18-22 × 6-8 μm. Paraphyses simple.
TLC: Stictic, constictic and norstictic acids.
This species is distinguished by yellowish-white stroma, round to elongate lirellae, spores 4-6-loculed, 18-22 × 6-8 μm. The species is known from Kerala and is distributed in tropical America.

Specimen examined:

India, Kerala, Mallapuram district, Calicut University Campus, on bark, 1975, Singh & Ranjan 102235 pr. p. (LWG).

2. *Sarcographa labyrinthica* (Ach.) Mull. Arg. Memoir. Soc. Phys. et Hist. Nat. Genéve 29 (8): 62 (1887).
Glyphis labyrinthica Ach., Syn. Lich.: 107 (1814).
Type collection: Guinea-not seen.

Pl. 1, fig. 5; Text-figs. 3-4

Thallus crustose, corticolous, greenish-yellow. Stroma white, 2-13×1-4 (-6) mm. Apothecia lirellate. lirellae black, confluent, covered by a white pruinose mass. Exciple complete, black, (12-) 26-40 μm thick. Epithecium brown. Hymenium colourless, 40-80 (-106) μm high, I-. Hypothecium pale yellow, 26-40 μm thick. Asci cylindrico-clavate, 8-spored, (40-) 60-74× (10-) 14-16 μm. Spores pale brown, 4-6-loculed, 14-18 (-20)×6-8 μm. Paraphyses simple.
TLC: Stictic, constictic and norstictic acids.

The species is distinguished by white stroma, black lirellae covered by white pruinose mass, spores 4-6-loculed, 14-18 (-20)×6-8 μm. The taxon is known from Eastern India, peninsular India and Andaman Islands and is distributed in Western Europe and tropical regions of world.

Specimens examined :

India, Andaman Islands, S. Andaman, Port Blair, 1961, Singh & Party 78865 (LWG); Wimberly Ganj, 1961, Singh & party 88166, 88168 (LWG); Long Island, Middle Andaman, sea level, 1961, Singh & party 89406 (LWG). Arunachal Pradesh, Dibang valley district, Roing, forest near Rayang village, alt. 400 m, on bark, 1986, Upreti & Ranjan 201544 (LWG). Assam, near Tezpore, 1879 A. Watt (GLAM). Kerala, Mallapuram district, Calicut University Campus, on bark of cashewnut tree, 1979, Awasthi, Upreti & Misra 79.767 (LWU), same locality, on bark of *Macaranga indica*, 1975, Singh & Ranjan 102265 (LWG); Ernakulum, near Multanmutti, along road side, on bark of trees, 1973, Singh 73.283 (LWU); Piravum road Rly. station, on bark of tree, 1973, Singh 73.332 (LWU).

3. *Sarcographa maculosa* (Stirton) Zahlbr. Cat. lich. univ. 2: 464 (1924).
Glyphis maculosa Stirton, Proc. Phil. Soc. Glasgow 13: 189. 1881 (1882).
Type collection—(India), Assam, A. Watt (Holotype: GLAM).

Pl. 1, fig. 6

Thallus crustose, corticolous, yellow-brown, smooth to slightly verrucose. Stroma yellowish-white, 4-8×3-5 mm, apothecia-lirellate, thin with somewhat crenate margin, round, elongate to effigurate, simple to branched, sparse to dense, (0.25-) 0.5-1×0.1 mm. Exciple brown, complete, (14-) 26-42 μm thick. Epithecium brown. Hymenium colourless, 66-80 μm high, I-. Hypothecium pale yellow, 26-30 μm thick. Asci 8-spored. Spores pale brown, 4-6-loculed, 20-26× 6-8 μm. Paraphyses simple.
TLC: Stictic, constictic and norstictic acids.

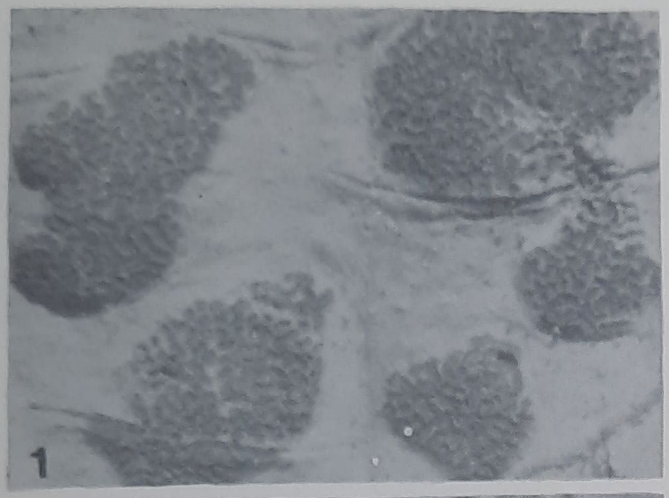
The species is distinguished by yellowish-white stroma, narrow, crenulate lirellae, spores 4-6-loculed, 20-26×6-8 μm. The taxon known from type collection is very close to *S. intricans* and hardly distinct from it except by slightly larger spores and crenate margin of apothecia. As the type of *S. intricans* has not been studied this taxon is being provisionally treated as an independent species.

4. *Sarcographa medusulina* (Nyl.) Mull. Arg. Flora 70: 77 (1887).
Glyphis medusulina Nyl., Acta Soc. Sci. Fenn. 7: 485 (1863). Type collection: Nova Granata-not seen.

Pl. 1, fig. 7

Thallus crustose, corticolous, yellow, smooth to slightly verrucose. Stroma yellowish, 1.5-4×1-3 mm. Apothecia lirellate, lirellae black, maculate, elongate, confluent, ca. 0.1-0.2 mm wide. Exciple brown-black, complete, 14-26 μm thick. Epithecium brown. Hymenium colourless, 40-66 μm high, I-. Hypothecium colourless, 12-26 μm thick. Asci clavate, 8-spored, ca 40×10 μm. Spores brown, 4-loculed, 14-18×6-8μm. Paraphyses simple.
TLC: Stictic, constictic and norstictic acids.

The species is distinguished by yellowish stroma, maculate lirellae and spores 4-loculed, 14-18×6-8 μm. It is known by a single collection from Assam and is distributed in the tropical regions of the world.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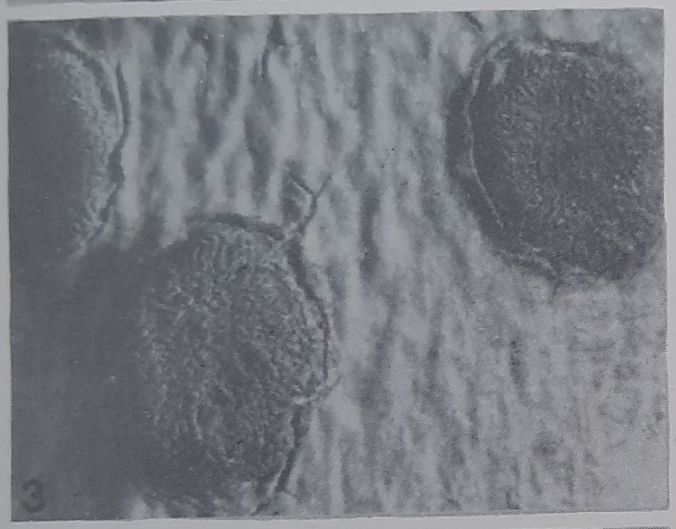
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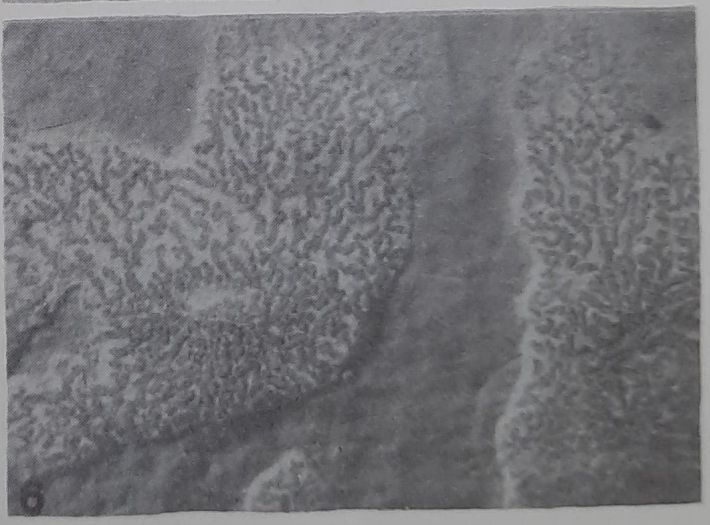
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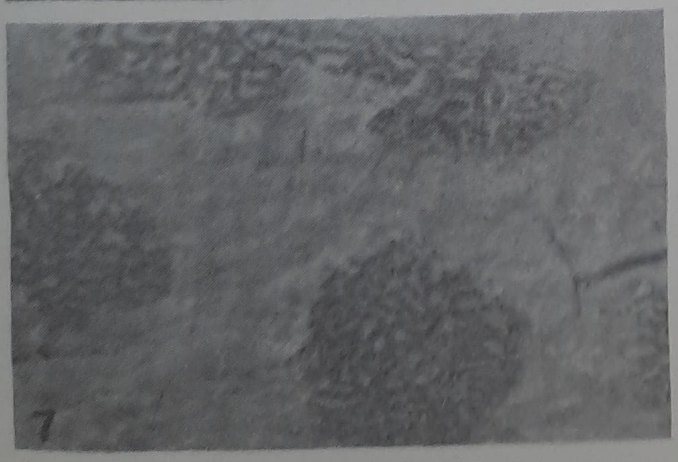
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Specimen examined :

(India), Assam, A. Watt (GLAM).

SARCOGRAPHINA Mull. Arg.

Flora 70: 425 (1887).

Sarcographina glyphiza (Nyl.) K. Singh and Awasthi, Bull. Bot. Surv. India 20: 139. 1978 (1979).

Graphis glyphiza Nyl., Ann. Sci. Nat. Bot. ser. 4, 19: 374 (1863).

Type collection China, Hongkong-not seen.

Sarcographina gyrizans Leighton, Trans. Linn. Soc. Lond. 27: 181 (1869).

Type collection: Sri Lanka-not seen.

Pl. 1, fig. 8; Text-figs. 5-6

Thallus crustose, corticolous, greenish-grey. Stroma white, 2-4.5 × 1-3 mm. Apothecia lirellate, lirellae black, elongate to effigurate, simple to branched, 1.25 × 0.1 mm (stroma cracked at margin and in between lirellae so that the lirellae are separated). Exciple black, complete, 40-66 μm thick. Epithecium brown. Hymenium colourless, 80-106 μm high, I-. Hypothecium yellow, 13-26 μm thick. Asci cylindrico-clavate, 6 (-8)-spored, 80-92 × 26-30 μm. Spores pale brown, muriform with 5-9 transverse and 0-1 vertical septa in median region (end regions lack vertical septa), 26-32 (-38) × 10-14 μm. Paraphyses simple.

TLC: Stictic, constictic and norstictic acids.

The species is distinguished by white stroma, elongate to effigurate lirellae and spores pale brown, muriform, 26-32 (38) × 10-14 μm. It is distributed in tropical Asia.

Specimen examined :

India, Assam, A. Watt (GLAM)-det. as *Glyphis gyrizans* Leighton. Kerala, Mallapuram district, Vallikunnu, on *Artocarpous*, 1975, Singh & Ranjan 102288 (LWG).

Acknowledgements

I am thankful to the keepers/curators of Herbaria of Glasgow Museums and Art Galleries, Glasgow (GLAM) and National Botanical Research Institute, Lucknow (LWG) for loan of specimans. I am also thankful to Dr D. D. Awasthi for suggestions in the manuscript and to Prof. C. P. Sharma, head, Department of Botany, Lucknow University, for providing laboratory facilities.

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Explanation of Plate

Plate 1

(All phologphs) are ca × 7.

1. *Glyphis cicatricosa* Ach.; D. D. Awasthi & G. Awasthi 84.39 (LWU).
2. *Glyphis confluens* Zenk.; Awasthi, Tewari & Mathur, 85.209 (LWU).
3. *Glyphis duriuscula* Stirton; A. Watt (Holotype: GLAM).
4. *Sarcographa intricans* (Nyl.) Mull. Arg.; Singh & Ranjan 102235 pr. p. (LWG).
5. *Sarcorgrapha labyrinthica* (Ach.) Mull. Arg.; Singh 73.283 (LWU).
6. *Sarcographa maculosa* Stirton; A. Watt (Holotype: GLAM).
7. *Sarcographa medusulina* (Nyl.) Mull. Arg.; A. Watt (GLAM).
8. *Sarcographina glyphiza* (Nyl.) K. Singh & Awasthi; Singh & Ranjan 102288 (LWG).