Int. J. Adv. Res. Sci. Technol. Volume 6, Issue1, 2017, pp.670-673.

IJARST

International Journal of Advanced Research in Science and Technology

journal homepage: www.ijarst.com

ISSN 2319 – 1783 (Print)

ISSN 2320 – 1126 (Online)

Notes on the family *Graphidaceae* in Sikkim, India.

G. Swarnalatha*

Botanical Survey of India, Deccan Regional Centre, Hyderabad-500048, Telangana, India.

****Corresponding Author's Email: swarnalathaginnaram@gmail.com***

ARTICLEINFO

Article history:

Received : 10 Jan. 2017

Accepted : 13 Feb. 2017

Available online : 24 Feb. 2017

Keywords:

Lichenised Fungi,

New combination,

New records,

Taxonomy.

PAPER-QR CODE

IJARST

Volume 6, Issue 1

ABSTRACT

An account of family *Graphidaceae* (Graphidoid *Graphidaceae*) of Sikkim is presented here. A total of 30 species of Graphidoid *Graphidaceae* spread over five genera are enumerated in this paper. Of these, one species, *Graphis inversa*, is reported here as a new record for India and 16 species are reported here as new records for the state of Sikkim.

© 2017 International Journal of Advanced Research in Science and Technology (IJARST). All rights reserved.

Citation: *Swarnalatha, G., Notes on the family Graphidaceae in Sikkim, India. Int. J. Adv. Res. Sci. Technol. Volume 6, Issue 1, 2017, pp.670-673.*

Introduction:

Sikkim, is the smallest of the North-Eastern States of India and lies between 88°00′ E to 88°55′ E longitude and 27°43′ N to 28°04′ N latitude. It covers a total area of 7,096 sq. km. The altitude ranges between 250 to 8586 m above mean sea level. The state shares its border with Nepal to the west, Bhutan to the south-east, Tibet to the north and north-east and Darjeeling district of West Bengal to the south. Politically, the state has been divided into four districts *viz.*, North, East, West and South. The state harbours rich diversity of flora and fauna, including lichens. As part of revisionary studies on family *Graphidaceae* in India, specimens of the family *Graphidaceae* collected from different parts of Sikkim and deposited in different Indian herbaria (BSA, BSHC, LWG) were investigated. As a result, a total of 30 species of Graphidoid *Graphidaceae* in six genera were identified. Of these, one species was found to be a new record for India and 16 species were found to be new records for the state of Sikkim. All the identified taxa are enumerated here citing the complete list of specimens examined. The species reported as new to the State of Sikkim are marked by an asterisk (*).

Materials and Methods:

The present study is based mainly on the collections made by the author from Sikkim during field tours undertaken in 2010 and on the specimens already collected from different localities of Sikkim by earlier collectors, which were deposited in the herbarium at Botanical Survey of India, Central Regional Centre, Allahabad (BSA). Besides, specimens from Sikkim that are housed in the herbaria at Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok (BSHC) and National Botanical Research Institute, Lucknow (LWG) were also borrowed on loan and investigated. All the specimens cited below were studied at Lichen Laboratory, Botanical Survey of India, Central Regional Centre, Allahabad, during December 2007 and March 2012.

The morphological features of the thalli and ascocarps were studied under stereo zoom microscopes (Olympus SZ51 and Nikon SMZ1500) and anatomical characters were examined with compound microscopes (Magnüs MLX-Tr and Leica DM2500). All anatomical measurements were made in water mounts. Colour spot tests were performed by using K, C and PD reagents. The lichen substances were identified by Thin Layer Chromatography (TLC) using solvent system A, following White & James (1985). All specimens were examined under UV light (365 nm). The methodology and the concept of Staiger 2002, Lücking & Rivas Plata 2008, Lücking 2009, Lücking *et al.* 2009 have been followed here.

Enumeration of Taxa:

Diorygma hieroglyphicum (Pers.) Staiger & Kalb, in Staiger, Biblioth. Lichenol. 85: 151. 2002.

*Specimen examined***:** South Sikkim District, Tendong, Biodiversity Park, alt. *c.* 2009 m, 26 Nov. 2006, *G.P. Sinha* 3810 (BSA).

Diorygma junghuhnii (Mont. & Bosch) Kalb, Staiger & Elix, Symb. Bot. Upsal. 34(1): 157. 2004.

*Specimens examined***:** East Sikkim District, On way between S. Rigu and Picrae forest, alt. *c.* 1900 m, 13 Apr. 1995 *G.P. Sinha* 517C (BSHC); Ranipool Souremi village area, alt. *c.* 1890 m, 20 Nov. 2006, *G.P. Sinha* 3609A, 3609B & 3609C (BSA); Gangtok-Dikchu-Singtan road, Pangthang-Rokshe, alt. *c.* 1898–1795 m, 21 Nov. 2006, *G.P. Sinha* 3628 (BSA); Gangtok–Dikchu–Singtan road, Tumin, alt. *c.* 1489 m, 21 Nov. 2006, *G.P. Sinha* 3632A & B (BSA); Simiklingey-Patukchandy, alt. *c.* 777 m, 21 Nov. 2006, *G.P. Sinha* 3653A, B & C (BSA); Rumtek-Sang, alt. *c.* 1450 m, 25 Nov. 2006, *G.P. Sinha* 3764A (BSA); Tarku, alt. *c.* 643 m, 26 Nov. 2006, *G.P. Sinha* 3777A, B, & C (BSA); Majitar, Rangpo, alt. *c.* 355 m, 27 Nov. 2006, *G.P. Sinha* 3839B (BSA).

***Diorygma megasporum** Kalb, Staiger & Elix, Symb. Bot. Upsal. 34(1): 160. 2004.

Specimens examined: West Sikkim District, Tashiding-Yonsum Road, near Chongrung village, alt. *c.* 1500 m, 10 Dec. 1994, *G.P. Sinha* 294 & 297 (BSHC); Kongri village forest, alt. *c.* 2000 m, 13 Dec. 1994, *G.P. Sinha* 330 (BSHC); East Sikkim District, On way between S. Rigu and Picrae forest, alt. *c.* 1900 m, 13 Apr. 1995, *G.P. Sinha* 517A & 517B (BSHC); Penangla, 27°22.239′N, 88°36.853′E, alt. *c.* 1880 m, 19 Nov. 2006, *G.P. Sinha* 3606A & C (BSA); Ranipool Souremi village area, alt. *c.*1890 m, 20 Nov. 2006, *G.P. Sinha* 3609D (BSA); Chongey, 27°20.656′N, 88°38.812′E, alt. *c.* 1784 m, 23 Nov. 2006, *G.P. Sinha* 3663A & B (BSA); Bhusuk, alt. *c.* 1430 m, 23 Nov. 2006, *G.P. Sinha* 3670A, B & C (BSA); Assam Lingzey, 27°16.788′N, 88°36.330′E, alt. *c.* 1078 m, 23 Nov. 2006, *G.P. Sinha* 3680A, B, C & 3682 (BSA); East Sikkim District, Gangtok, Hanuman Tok-Salep tank, alt. *c.* 2000 m, 24 Nov. 2006, *G.P. Sinha* 3737 (BSA); Rumtek, alt. *c.* 1223 m, 25 Nov. 2006, *G.P. Sinha* 3753 (BSA); Rumtek-Sang, alt. *c.* 1450 m, 25 Nov. 2006, *G.P. Sinha* 3764B (BSA).

Glyphis cicatricosa Ach., Syn. Meth. Lich.: 107. 1814.

*Specimens examined***:** East Sikkim District, Penangla, alt. *c.* 1880 m, 19 Nov. 2006, *G.P. Sinha* 3605 (BSA); Bhusuk, alt. *c.* 1430 m, 23 Nov. 2006, *G.P. Sinha* 3675 (BSA).

Graphis acharii Fée, Essai Crypt. Ecorc.: 39, tab. 10, fig. 4. 1824.

*Specimens examined***:** East Sikkim District, Gangtok, Near Tashi view point, 17 Nov. 1977, *P.G. Patwardhan & M.B. Nagarkar* 77. 1950 (CAL); East Sikkim District, Pengala, 27°22′21.2″N, 88°35′58.2″E, alt. *c.* 1905 m, 24 May 2008, *T.A.M. Jagadeesh Ram* 4487 (BSA).

***Graphis albidofarinacea** Adaw. & Makhija, Mycotaxon 96: 53. 2006.

Specimens examined: West Sikkim District, Tashiding-Legshep Road, near river bridge, alt. *c.* 1300 m, 09 Dec. 1994, *G.P. Sinha* 290 (BSHC); Karchi village surroundings, alt. *c.* 2000 m, 18 Dec. 1994, *G.P. Sinha* 446 (BSHC).

***Graphis cf. albissima** Müll. Arg., Bull. Herb. Boissier 3: 319. 1895.

*Specimen examined***:** East Sikkim District, Majitar, Rangpo, 27 Nov. 2006, *G.P. Sinha* 3840 (BSA).

***Graphis bipartita** (Müll. Arg.) Lücking, in Lücking, Chaves, Sipman, Umaña & Aptroot, Fieldiana, Bot. 46: 61. 2008.

*Specimen examined***:** East Sikkim District, Gangtok, Hanuman tok-Salep tank, alt. *c.* 2000 m, 24 Nov. 2006, *G.P. Sinha* 3736 (BSA).

Graphis chlorotica A. Massal., in Kremp., Verh. K. K. Zool. -Bot. Ges. Wein. 21: 865. 1871.

*Specimen examined***:** North Sikkim, Kabi, 27°23′37.6″N, 88°38′12.3″E, alt. 1609 m, 24 Apr. 2010, *G. Swarnalatha* 5826B (BSA).

***Graphis furcata** Fée, Essai Crypt. Ecorc. : 40. 1824.

*Specimen examined***:** North Sikkim District, 1 km to Koha, on the way to Phodong, 27°02′16.2″N, 92°36′22.4″E, alt. 1547 m, 24 Apr. 2010, *G. Swarnalatha* 5836/B (BSA).

***Graphis garoana** Nagarkar & Patw., Biovigyanam 8: 126. 1982.

*Specimen examined***:** South Sikkim District, Namchi, 4 km towards Jorthang, alt. *c.* 1500 m, 01 Apr. 2001, *Upreti & Chatterjee* 219533A (LWG).

***Graphis llinata** Eschw., in Martius, Fl. Bras. 1: 82. 1833.

*Specimen examined***:** East Sikkim District, Tashi view point, alt. *c.* 1885 m, 24 May 2008, *T.A.M. Jagadeesh Ram* 4474 (BSA).

***Graphis inversa** Harris R.C., Some Florida lichens: 21. 1990. (Figure 1).

Figure: 1. *Graphis inversa*

Type: Florida, Franklin country, Apalachicola National Forest, Black creek at end of forest service road 101A, *c.* 2 miles of Sumatra, 01 Dec. 1988, *Harris* 23223 (Holotype: NY).

Thallus corticolous, epi-endophloeodal, irregular in outline, delimited by greyish-white to black prothallus; surface greyish-white to creamy, smooth to finely wrinkled, continuous. Thallus in section ecorticate. Photobiont *Trentepohlia*.

Ascomata lirelliform, conspicuous, black, slender, scattered all over the thallus, erumpent to prominent, simple, 0.5–2 mm long, 0.05–0.1 mm broad, straight to curved or flexuous, blunt at the ends; disc closed, epruinose; excipulum complete, laterally carbonised, indistinct to thin lemon yellow to golden yellow at base, covered by lateral to basal thalline margin, numerous crystals present in thalline margin; labia convergent, entire; hymenium hyaline, not inspersed, I–, 48–64 µm high; epihymenium orange-brown, K+ purple, *c.* 8 µm thick; subhymenium hyaline, 9–11 µm thick. Paraphyses unbranched; tipsbrown walled and fused. Asci ellipsoid, *c.* 55 × 13 µm. Ascospores 8 per ascus, ellipsoid, transversely septate, 12–22 × 5–8 µm, 6–8 locular, hyaline, I+ blue violet.

Chemistry:

Thallus K–, C–, KC–, P–, UV–; epihymenium K+ purple (tetra-hydroxy-anthraquinone-1,3,6,8 and related substances); no lichen substances detected by TLC.

Remarks:

This species is characterised by erumpent to prominent, black, simple, slender and short lirellae; closed, epruinose disc; convergent, entire labia; laterally carbonized excipulum; clear hymenium; orange-brown pigmented epihymenium which reacts with K and turn pink to purple; short (12–22 × 5–8 µm), hyaline, 6–8 locular ascospores. In morphology and anatomy *G. inversa* resembles *G. pinicola* but later differs by its slightly larger (25–35 × 10–12 µm) ascospores, often sparsely branched lirellae and absence of orange pigment in epihymenium (tetra-hydroxy-anthraquinone-1,3,6,8 and related substances).

Distribution:

This species was earlier reported from Florida by Harris (1990). It is now reported here from Sikkim, India.

*Specimen examined***:**

North Sikkim District, 1 km to Koha, on the way to Phodong, 27°02′16.2″N, 92°36′22.4″E, alt. *c.* 1547 m, 24 Apr. 2010, *G. Swarnalatha* 5835/A (BSA).

***Graphis leptoclada** Müll. Arg., Flora 65: 335. 1882

*Specimen examined***:** East Sikkim District, near Samdong, on the way to Dikchu, 27°02′16.2″N, 92°36′22.4″E, alt. *c.* 940 m, 21 Apr. 2010, *G. Swarnalatha* 5727 (BSA).

***Graphis librata** C. Knight., Trans. New Zealand Inst. 16: 404. 1884.

*Specimen examined***:** East Sikkim District, Ranipool, Souremi village area, alt. *c.* 1890 m, 20 Nov. 2006, *G.P. Sinha* 3612D (BSA).

Graphis longiramea Müll. Arg., J. Linn. Soc., Bot. 29: 225. 1892.

*Specimens examined***:** West Sikkim District, Lahdang forest, alt. *c.* 1900-2000 m, 19 Dec. 1994, *G.P. Sinha* 470 (BSHC); East Sikkim District, Penangla, 27°22.239′N, 88°36.853′E, alt. *c.* 1880 m, 19 Nov. 2006, *G.P. Sinha* 3606B (BSA).

***Graphis macella** Kremp.**,** Flora 59: 380. 1876.

*Specimens examined***:** West Sikkim District, on the way between Narkuola-Karchi village, alt. *c.* 2100–1850 m, 14 Dec. 1994, *G.P. Sinha* 384 (BSHC); West Sikkim District, On the way between Narkuola-Karchi village, alt. *c.* 2100–1850 m, 14 Dec. 1994, *G.P. Sinha* 384 (BSHC); East Sikkim District, Pengala, 27°22′24.7″N, 88°35′56.6″E, alt. *c.* 1948 m, 24 May 2008, *T.A.M. Jagadeesh Ram* 4483 (BSA).

Graphis marginata Raddi., Raddi, G., Mem. Soc. Ital. Sc. 18: 344, tab. 3, fig. 2. 1820.

*Specimen examined***:** South Sikkim District, Majitar, Rangpo, alt. *c.* 355 m, 27 Nov. 2006, *G.P. Sinha* 3839A (BSA).

***Graphis neoraensis** Jagadeesh & G.P. Sinha, Mycotaxon 110: 32. 2009.

*Specimen examined***:** North Sikkim District, Kabi, 27°23′37.6"N, 88°38′12.3"E, 1609 m alt., 24 Apr. 2010, *G. Swarnalatha* 5826/A (BSA).

***Graphis parilis** Kremp., Flora 59: 422 & 445. 1876.

*Specimens examined***:** East Sikkim District, Ranipool, Souremi village area, alt. *c.* 1890 m, 20 Nov. 2006, *G.P. Sinha* 3612A, C & E (BSA); North Sikkim District, Dikchu, 27°23.612′N, 88°30.967′E, alt. *c.* 725 m, 21 Nov. 2006, *G.P. Sinha* 3646A (BSA); Bhusuk, alt. *c.* 1430 m, 23 Nov. 2006, *G.P. Sinha* 3671 (BSA);

Tarku, alt. *c.* 643 m, 26 Nov. 2006, *G.P. Sinha* 3778 (BSA); East Sikkim District, near Makha, on the way to Dikchu, 800-940 m alt., 21 Apr. 2010, *G. Swarnalatha* 5692B (BSA).

***Graphis cf. pavoniana** Fée**,** Essai Crypt. Ecorc. 40. 1825.

*Specimen examined***:** East Sikkim District, Gangtok, Bhaluakhani, BSI campus, 27°20.379′N, 88°36.812′E, 25 Nov. 2006, *G.P. Sinha* 3747 (BSA).

***Graphis pertricosa** (Kremp.) A.W. Archer, Telopea 11: 73. 2005.

*Specimens examined***:**Temi-Danothang, 27°13.802′N, 88°24.914′E, alt. *c.* 1853 m, 26 Nov. 2006, *G.P. Sinha* 3790B (BSA); West Sikkim, Somharia forest rest house campus, on *Pinus* bark, alt. *c.* 1700 m, 20 Nov. 1997, *G.P. Sinha* 1278 (BSHC).

Graphis proserpens Vain., Bot. Tidsskr. 29(2): 132. 1909.

*Specimens examined***:** South Sikkim District, On Damthang-Tendong 6 km trek, alt. *c.* 2000-2650 m, 07 May 1994, *G.P. Sinha* 126 (BSHC); East Sikkim, Gangtok, Hanuman Tok-Salep tank, alt. *c.* 2000 m, 24 Nov. 2006, *G.P. Sinha* 3734 (BSA); South Sikkim District, Tendong, Biodiversity Park, alt. *c.* 2009 m, 26 Nov. 2006, *G.P. Sinha* 3803 (BSA).

***Graphis semirigida** (Müll.Arg.) Lücking, in Lücking, Archer & Aptroot, Lichenologist 41 (4): 437. 2009.

*Specimens examined***:** West Sikkim District, on the way between Narkuola-Karchi village, alt. *c.* 2100–1800 m, 14 Dec. 1994, *G.P. Sinha* 384 (BSHC).

Graphis striatula (Ach.) Spreng., Syst. Veg. Lich. 4: 250. 1827.

*Specimens examined***:** East Sikkim District, Penangla, 27°22.239′N, 88°36.853′E, alt. *c.* 1880 m, 19 Nov. 2006, *G.P. Sinha* 3593 (BSA); Rumtek-Sang, 25 Nov. 2006, *G.P. Sinha* 3765 (BSA).

***Graphis subvittata** Adaw. & Makhija, Mycotaxon 99: 322. 2007

*Specimen examined***:** East Sikkim District, 5 km to Rhenok, on the way to Rishi, N 27°02′16.2″ E 92°36′22.4″, alt. *c.* 652 m, 22 April 2010, *G. Swarnalatha* 5797(BSA).

Graphis vittata Müll. Arg., Flora 65: 335. 1882

*Specimens examined***:** North Sikkim District, Dikchu, 27°23.612′N, 88°30.967′E, alt. *c.* 725 m, 21 Nov. 2006, *G.P. Sinha* 3646B (BSA); Phodong Monastery, alt. *c.* 1678 m, 24 Apr. 2010, *G. Swarnalatha* 5863 (BSA); North Sikkim District, near Phodong Monastery, 27°23′58.7″N, 88°36′38″E, alt. 1678 m, 24 Apr. 2010, *G. Swarnalatha* 5863 (BSA).

Pallidogramme chlorocarpoides (Nyl.) Staiger, Kalb & Lücking, in Lücking, Chaves, Sipman, Umaña & Aptroot, Fieldiana, Bot. 46: 9. 2008.

*Specimens examined***:** East Sikkim District, Way between Talkharka-Lower Rechala, alt. *c.* 2000–2200 m, 14 Apr. 1996, *G.P. Sinha* 984 (BSHC); Penangla, 27°22.239′N, 88°36.853′E, alt. *c.* 1880 m, 19 Nov. 2006, *G.P. Sinha* 3607 (BSA).

***Pallidogramme chrysenteron** (Mont.) Staiger, Kalb & Lücking, in Lücking, Chaves, Sipman, Umaña & Aptroot, Fieldiana, Bot. 46: 9. 2008.

*Specimens examined***:** South Sikkim District, Namchi, Public Health Point, alt. *c.* 1800 m, *Dudhiya* tree trunk, 01 Apr. 2001, *Upreti & Chatterjee* 219522 (LWG); East Sikkim District, Gangtok, Hanuman tok-Salep tank, alt. *c.* 2000 m, 24 Nov. 2006, *G.P. Sinha* 3730A (BSA).

Platygramme caesiopruinosa (Fée) Fée, Bull. Soc. Bot. France 21: 30. 1874.

*Specimen examined***:** West Sikkim District, near Karchi village, alt. *c.* 2100 m, 13 Dec. 1994, *G.P. Sinha* 345 (BSHC).

Acknowledgements:

The author is thankful to present and former Director, Botanical Survey of India, Kolkata, and to former Heads of Office, Botanical Survey of India, Central Regional Centre, Allahabad, for facilities. Thanks are also due to the authorities of BSHC and LWG for loan of specimens. She is grateful also to Ministry of Environment, Forests and Climate Change, Government of India, New Delhi, for financial support under its All India Coordinated Project on Taxonomy (AICOPTAX) scheme during December 2007 to March 2012.

References:

1. Harris, R.C. 1990. Some Floridan Lichens. Publ. by the author, Bronx, New York.
2. Lücking, R. 2009. The taxonomy of the genus *Graphis sensu* Staiger: (*Ostrapales: Graphidaceae*). *Lichenologist* 41: 319–362.
3. Lücking, R., Archer, A.W. & Aptroot, A. 2009. A world-wide key to the genus *Graphis* (*Ostropales: Graphidaceae*). *Lichenologist* 41(4): 363–452.
4. Lücking, R. & Rivas Plata, E. 2008. Clave y guıailustrada para géneros de *Graphidaceae*. *Glalia*1**:** 1–41.
5. Nagarkar, M.B. & Patwardhan, P.G. 1982. Notes on some lichens from North-East India IV: Genus *Graphis*. *Biovigyanam* 8: 125–131.
6. Staiger, B. 2002. Die Flechn familie *Graphidaceae*: Studien in Richtung einer naturlicheren Gliederung. *Biblioth. Lichenol.* 85: 1–526.
7. White, F.J. & James, P.W. 1985. A new guide to microchemical techniques for the identification of lichen substances. *British Lichen Society Bulletin* 57 (Supplement): 1–41.