Pak. J. Bot., 40(5): 2143-2148, 2008.

OCCURRENCE OF THE FAMILIES NAVICULACEAE AND SURIRELLACEAE (BACILLARIOPHYTA) IN THE PUNJAB AND N. W. F. P., PAKISTAN

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Abstract

Seven species of pennate diatoms belonging to 4 genera were collected from different freshwater habitats at Lahore and Sheikhupura districts (Punjab) and Sawat Valley (NWFP) of Pakistan during April and September 2004. They were identified and taxonomically described for the first time from their area of collection. They mainly occurred in spring, started diminishing in summer and autumn, and disappeared in winter. The genus *Colletonema* and its three species viz., *C. eximium*, *C. neglectum* and *C. subcohaerens* as well as *Luticola mutica* are being reported for the first time from Pakistan. Sexual reproduction was not observed in them.

Introduction

A large survey was made for the collection of pennate diatoms (Bacillariales) from a variety of freshwater habitats in different areas of the Punjab, NWFP and Azad Kashmir. Gradually, various species were separated from the collected material and identified. As a result of that, species of the genera such as *Cymbella* C. A. Agardh, *Navicula* Bory de Saint - Vincent *emend*. Cleve and *Nitzschia* Hassall as well as those of the family Pinnulariaceae have been taxonomically described (Tariq-Ali *et al*., 2006a-d, 2007). Present study is a continuation of these investigations. It includes taxonomic enumeration of the species belonging to the families Naviculaceae and Surirellaceae.

Materials and Methods

Diatoms were collected from various freshwater habitats at Lahore and Sheikhupura districts (Punjab) and Swat Valley (NWFP) of Pakistan during April and September 2004. Methods for the collection, preservation, microscopic examination and preparation of drawings were the same as have been described before (Tariq-Ali *et al*., 2006c, d). The species were identified with the help of authentic literature (West, 1904; Østrup, 1908; Salim & Khan, 1960; Starmach, 1964; Foerster & Schlichting Jr., 1965; Gerloff & Lüdemann, 1966; Cholnoky, 1970; Giffen, 1970; Nizamuddin, 1984). The voucher specimens are kept in the Phycology & Phycochemistry Lab. (Room No. 18), MAH Qadri Biological Research Centre, University of Karachi, where the work was conducted.

Results and Discussion

The morphological and cytological examination of the collected material revealed the presence of seven diatomaceous species belonging to two families. They were identified, taxonomically described and systematically arranged according to the newly proposed classification (Shameel, 2001). Their taxonomic enumerations are as follows:

Family Naviculaceae

Frustules of valves are symmetrical in both axes. Valve may be elliptical, lanceolate, or bent shaped in outline. The sagital axis is usually linear, may be sigmoid. Each valve has a raphe with distinct central and polar nodules. Valves are transversely punctate. Chromatophores two, laminate in each specimen. The following three genera of this family have been collected:

1. Frustules with straight raphe …….. *Navicula*
   Frustules biraphid ……... 2

2. Margins straight to undulate …….. *Frustulia*
   Margins protracted …….. *Luticola*

Frustulia* Rabenhorst 1853: 50*, nom. cons.

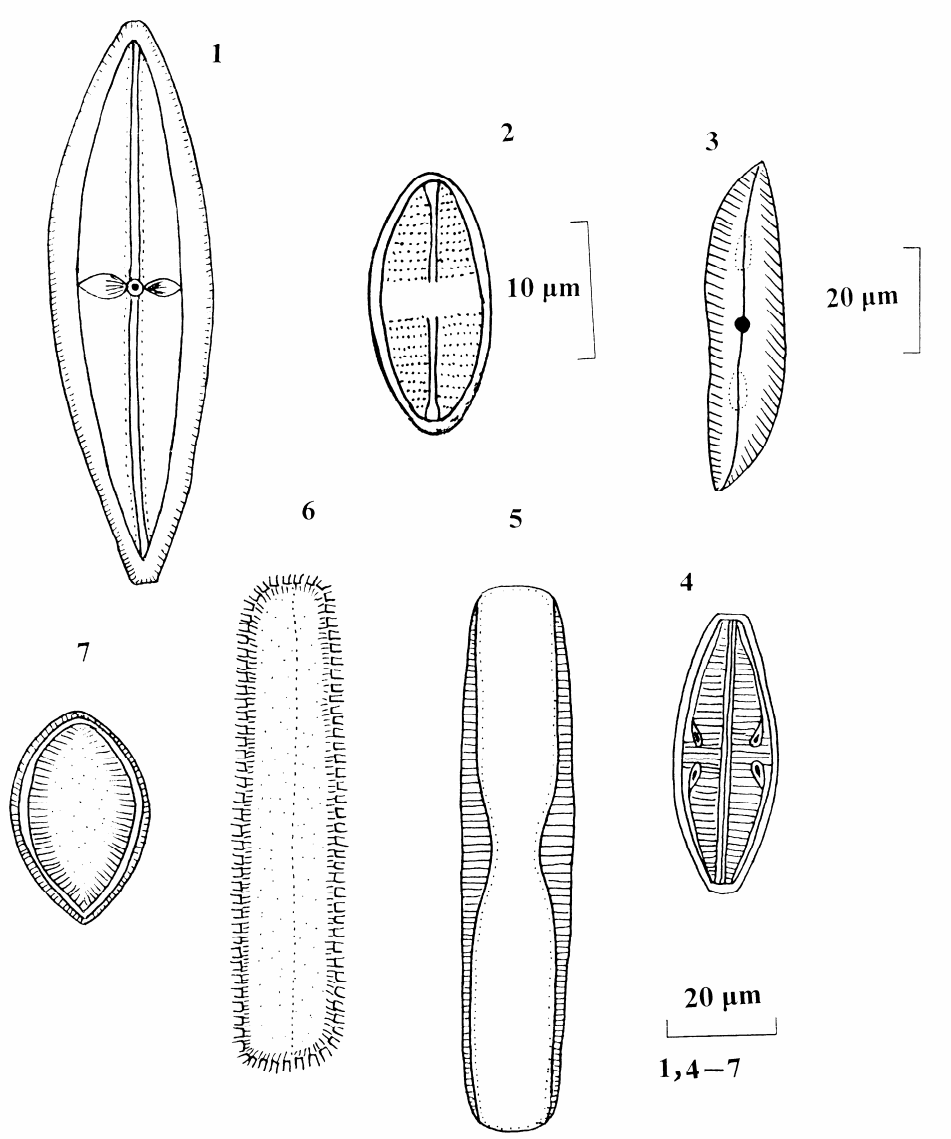
Frustules biraphid, rhomboidal to linear-lanceolate, with straight to undulate margins. Raphe contained in a median rib extending most of the length of the valve, proximal and distal raphe ends not clearly observed with light microscopy. At the apices the raphe rib has the appearance of a pencil or crayon tip. Striae fine, arranged so as to produce a pattern of apical and transapical rows. Cells single or occasionally occurring in mucilaginous tubes. It included only the following species in the present collection.

1. *F. rhomboides* (Ehrenberg 1843) De Toni 1891: 277

Basionym: *Navicula rhomboides* Ehrenberg 1843.
References: Østrup, 1908: 262; Foerster & Schlichting Jr., 1965: 490; Gerloff & Lüdemann, 1966: 107; Nizamuddin, 1984: 54; Leghari *et al*., 1991: 10.
General characters: Cells are boat-shaped, rectangular; two ribs from central nodules run parallel to the raphe; frustule-length 80-85 µm and width 23-24 µm (Fig. 1).
Cytological features: Chromatophore one, elongate.
Locality: N W F P: Kalam, Swat (14-8-2004).
Geographical distribution: Pakistan, Libya, Ontario (Canada), Faeröes (Denmark).
Remarks: The specimens were collected during summer from slow running water between Bahreen and Kalam. Sexual reproduction was not observed. The material was obtained in the vegetative form only.

***Luticola* D. G. Mann *in* F. E. Round, R. M. Crawford *et* D. G. Mann 1990: 670**

Frustules biraphid, symmetrical to the apical and transapical axes, apices protracted, puncta distinct, central area expanded with a distinct stigma present. Raphe straight, with proximal ends slightly recurved in the same direction, distal ends curved. Easily recognized by naviculoid symmetry and expanded central area with stigma and recurved proximal raphe ends. Material included only one species.



Figs. 1-7. Diatoms from Punjab and N.W.F.P., Pakistan: 1. *Frustulia rhomboides*, 2. *Luticola mutica*, 3. *Colletomema eximium*, 4. *C. neglectum*, 5. *C. subcohaerens*, 6. *Surirella delicatissima*, 7. *S. ovalis*.

2. *L. mutica* (Kützing 1844: 29) D. G. Mann *in* F. E. Round, R. M. Crawford *et* D. G. Mann 1990: 670

Basionym: *Navicula mutica* Kützing 1844: 29.
References: Salim & Khan, 1960: 29; Gerloff & Lüdemann, 1966: 107; Cholnoky, 1970: 22; Nizamuddin, 1984: 77.

General characters: Frustules solitary, free floating; girdle linear, rectangular; valve rhomboidal, lanceolate, obtuse at the produced ends; raphe straight, length 18-25 µm and breadth 8-10 µm, 17-19 striae / 10 µm (Fig. 2).
Cytological features: Chromatophores two, green.
Localities: Sheikhupura District: between Mureedke and Narang Mundi (30-9-2004); Lahore District: Jinnah Garden (28-9-2004).
Geographical distribution: India: Amritsar, Jullundar; Pakistan: Peshawar, Lahore, Gujranwala; Libya.
Remarks: The specimens were collected during autumn from paddy fields between Mureedke and Narang Mundi and from fountain of Jinnah Garden. Reproduction was not observed. The specimens were collected in vegetative form.

Family Surirellaceae

Raphe are present on both margins of a valve. Costae are much more prominent near the margin of a valve than at the center. Frustules are quiet large. Girdle view is rectangular, sinuate. Chromatophores are single, auxospores are formed. Following two genera have been collected, which may be distinguished as follows:

1. Frustules filiform or globose, sigmoid or naviculoid ……... *Colletonema*
   Frustules otherwise; valve linear, elliptical ….…… *Surirella*

***Colletonema* de Brébisson *ex* Kützing 1849: 105**

Frond simple or divided, filiform or globose; frustules sigmoid or direct, naviculoid in files containing one or more rows of scattered frustules. The valve can usually be well seen after maceration in acid. This genus is being reported for the first time from Pakistan. Its following three species have been collected which may be distinguished as follows:

1. Frond filiform; valve sigmoid ..…….. *C. eximium* (3)
   Frond otherwise; valve elliptical, lanceolate ..……. 2

2. Extremities obtuse ……... *C. neglectum* (4)
   Extremities rounded ..……...……. *C. subcohaerens* (5)

3. *C. eximium* (Thwaites) Kützing 1849

General characters: Frond filiform, more or less abruptly acuminate, slightly rugulose, containing one or more rows of somewhat scattered frustules; valve sigmoid, extremities rounded, striated; striae 56 within 10 µm (Fig. 3).
Cytological features: Chromatophore single.
Locality: Lahore District: Badshahi Masjid (21-4-2004).
Geographical distribution: Britain, (UK).
Remarks: The specimens were collected during spring from fountains of Badshahi Masjid. Sexual reproduction was not observed. The material was obtained in vegetative form. This species is being reported for the first time from Pakistan.

4. *C. neglectum*

General characters: It is unicellular and slightly divided, obtuse, containing numerous and closely packed frustules; valve elliptical, lanceolate; extremities obtuse; striae 32 within 10 µm (Fig. 4).
Cytological features: Chromatophore single.
Locality: Lahore District: Zoological Garden (24-5-2004).
Geographical distribution: United States.
Remarks: The specimens were collected during spring from fountains of Zoological Garden. Sexual reproduction was not observed. The specimens were obtained in vegetative form only. This species is also being reported for the first time from Pakistan.

5. *C. subcohaerens* (Thwaites 1848) Kützing 1849

General characters: Frond globose, gelatinous, pervaded by fillies containing from one to five rows of frustules; valve elliptical, lanceolate with rounded extremities; striae 28 within 10 µm. Diameter of frond from 0.2-0.6 µm (Fig. 5).
Cytological features: Chromatophore single.
Locality: Lahore District: Zoological Garden (10-8-2004).
Geographical distribution: France.
Remarks: The specimens were collected during summer from fountains of Zoological Garden. Sexual reproduction was not observed. The material was obtained in vegetative form. This species is being reported for the first time from Pakistan.

Surirella Turpin 1828: 363

Frustules solitary or free-floating, girdle sub-rectangular; valve linear, elliptical, ends rounded; keel marginal, containing a raphe; costae short, transverse, parallel, reaching the pseudoraphe; intercostal striae fine and delicate; pseudoraphe centrally placed, linear or lanceolate; chromatophores two, lying along the girdle and joined by a bridge like connection in the middle. The present collection included the following two species, which may be distinguished as follows:

1. Valve linear, lanceolate …….. *S. delicatissima* (6)
   Valve ovate ..…….*S. ovalis* (7)

6. *S. delicatissima* F. W. Lewis 1864

Reference: Starmach, 1964: 551.
General characters: Frustules linear, rounded at the ends; valve linear, lanceolate, sometimes very slightly constricted in the middle, with acute apices; costae 8-10 µm; striae about 20 within 10 µm; pseudoraphe well defined, lanceolate, length 90 µm (Fig. 6).
Cytological features: Chromatophores two, lying along the girdle.
Locality: Lahore District: Shalimar Garden (26-4-2004).
Geographical distribution: United States, Poland.
Remarks: The specimens were collected during spring from fountains of Shalimar Garden. Sexual reproduction was not observed. The material was obtained in vegetative form only.

7. *S. ovalis* de Brébisson 1838: 17

References: West, 1904: 304; Østrup, 1908: 286; Salim & Khan, 1960: 63; Starmach, 1964: 554; Foerster & Schlichting Jr., 1965: 491; Giffen, 1970: 96; Nizamuddin, 1984:102.
General characters: Valve ovate; costae short, marginal, radiate; intercostal striae and pseudoraphe scarsely visible; length of frustule 55-60 µm and breadth 25-30 µm; costae 4-5 within 10 µm (Fig. 7).
Cytological features: Chromatophores two, lying along the girdle.
Locality: Lahore District: Mahmood Booti (22-4-2004).
Geographical distribution: United States, Libya, Ontario (Canada), Poland, Faeröes (Denmark), Peshawar (Pakistan).
Remarks: The specimens were collected during spring from Mahmood Booti. Sexual reproduction was not observed. The material was obtained in vegetative form.

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(Received for publication 10 February 2008)