

**ADDITION TO OEDOGONIACEOUS ALGAE OF BANGLADESH:  
BULBOCHAETE AGARDH**

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**Abstract**

A total of nine taxa of *Bulbochaete* Agardh are reported from the north-west Barind tract of Bangladesh as new records for the country. These are *Bulbochaete crassa* Pringsh., *B. debaryana* Wittr. & Lund. in Wittr., *B. elatior* Pringsh. var. *elatior*, *B. iyengarii* Sarma & Mukh., *B. keralense* Venk. & Natr., *B. minuta* West & West, *B. nana* Wittr. var. *chungkingensis* Jao, *B. pygmaea* Pringsh. var. *erecta* Jao, and *B. suberecta* (Coll.) Tiff.

**Introduction**

The Oedogoniales is a unusual, highly specialized order of green algae. Morphologically *Oedogonium*, *Oedocladium* and *Bulbochaete* are markedly different from each other. They have no obvious ancestors, several other features common to other green algae (e.g. possession of the phycoplast) place them in the Chlorophyta (Mattox and Stewart 1984). Preliminary molecular data (Booton *et al.* 1998) confirm that they constitute a monophyletic, taxonomically isolated clade. Further, these data also provide the fact that *Bulbochaete* could be more basally placed phylogenetically than the other two genera. Gonzalves (1981) reported 109 species of the genus *Bulbochaete* from all over the world which was further updated by Mrozinska (1985), who reported a total of 113 species.

So far 14 taxa of *Bulbochaete* have been reported from Bangladesh (Islam and Sarma 1965, Islam 1972, Islam 1979, Aziz *et al.* 1991, Zaman 1991, Hasan 2000). In a recent investigation into some freshwater habitats of north-west Barind tract of Bangladesh recorded nine taxa of *Bulbochaete* which have not been reported from Bangladesh earlier. The present paper portrays illustrated accounts of these taxa.

**Materials and Methods**

The present study was carried out in the north-west Barind tract situated in between 88.2°-89.2°E longitude and 24.6°-25.2°N latitude of Bangladesh from November 2000 to March 2005. The descriptions and identification of all studied taxa are based upon the investigation of fertile, mature specimens collected between the 1<sup>st</sup> week of November and 1<sup>st</sup> week of March. The present study has concentrated on the *Bulbochaete* specimens growing on aquatic plants including charophytes. All the collected specimens were preserved

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in Transeau's solution. Camera lucida drawings were made at 400× magnification under a Reichert microscope (Nr. 309 209). Photomicrographs were taken by a Vivitar V3200 camera.

### Taxonomic enumeration

1. **Bulbochaete crassa** Pringsh. (Pl. 1, Figs 9a-c; Pl. 2, Fig. 6)

(Gonzalves 1981, 639, 10: 63)

Nannandrous, gynandrosporous, vegetative cells 16-19 × 40-58 μm, division of suffultory cell median or a little above median. Oogonium subdepressed-globose to globose patent, situated below a terminal setae, 50 × 39-43 μm. Oospore 46 × 35 μm, outer layer of spore wall scrobiculate, androsporangia up to 3-seriate, scattered, 12 × 13 μm. Dwarf males a little longer than the oogonia, 10 × 40 μm. Antheridium unicellular, exterior, 9 × 20 μm.

*Material studied:* Col. No. Bulbo-074, 12 February 2002, Dargahpara near Kakanhat at Godagari, Rajshahi, filaments attached to *Hygroryza aristata* (Retz.) Nees ex Wight & Arn.

*Distribution:* North America: United States (Massachusetts, Ohio, Wisconsin). Europe: Austria, Czechoslovakia, Germany, Poland, Switzerland (Gonzalves 1981, Mrozinska 1985).

2. **Bulbochaete debaryana** Wittr. & Lund. in Wittr. (Pl. 1, Fig. 1; Pl. 2, Figs 1, 7)

(Saito and Yamagishi 1973, 1: 1-2, 2: 5; Gonzalves 1981, 587, 10: 3)

Monoecious, macrandrous, vegetative cells 13-20 × 22-32 μm. Oogonium ellipsoid, situated below a vegetative cell or terminal setae. Oogonia 28-30 × 45-50 μm. Oospores 26-28 × 36-48 μm. Antheridium single or up to 3, 10-12 × 5-8 μm.

*Material studied:* Col. No. Bulbo-013, 2 March 2005, Andhasura beel in Naogaon, filaments attached to *Nitella hyalina* Agardh.

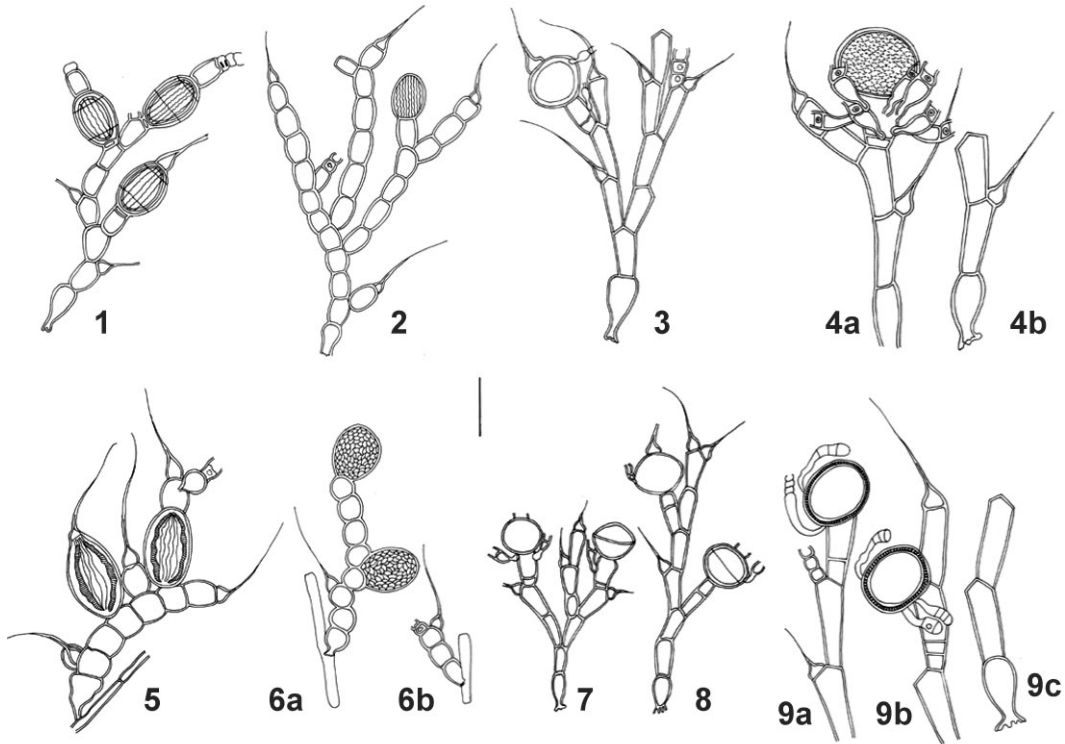
*Distribution:* North America: Alaska, Canada, Greenland. Europe: Poland, Sweden, U.S.S.R. (Estonian S.S.R.; Latvian S.S.R.) (Gonzalves 1981).

3. **Bulbochaete elatior** Pringsh. var. **elatior** (Pl. 1, Fig. 3; Pl. 2, Fig. 2)

(Gauthier-Lievre 1963-64, 237, 25: 4Aa; Gonzalves 1981, 602, 10: 22A)

Nannandrous, gynandrosporous, vegetative cells slender, 10.0-16.5 × 29.7-33.0 μm, division of suffultory cell basal. Oogonium depressed-globose, erect 42.9-45.2 × 33-36 μm. Oospore globose, 33-42 × 26-30 μm, spore wall smooth. Androsporangia single or two, epigynous, rarely scattered, 7-10 × 10 μm. Dwarf male situated on the suffultory cell, stipe straight, 8-9 × 16-20 μm; antheridium exterior, unicellular, 6-8 × 9-11 μm; basal division of the suffultory cell the exterior antheridium and the short dwarf males are the distinguishing characters of this species. Oogonia usually erect.

Mrozinska (1985) described this variety as two forma (f. *elator* and f. *pumila* Hirn); our material's morphology resembles with the description and measurement of *B. elator* var. *elator* f. *pumila* Hiorn.



**Plate 1**

Figs 1-9. 1. *Bulbochaete debaryana*, 2. *B. nana* var. *chungkingensis*, 3. *B. elator* var. *elator*, 4a, b. *B. keralense*, 5. *B. pygmaea* var. *erecta*, 6a, b. *B. iyengarii*, 7. *B. minuta*, 8. *B. suberecta*, 9a-c. *B. crassa*. (Scale = 50  $\mu$ m)

*Material studied:* Col. No. Bulbo-016, 1 January 2001, Uddran Dighi at Debour at Saphahar, Naogaon, filaments attached to *Cyperus tagetiformis* Roxb.

*Distribution:* Africa: Chad, Guinea, Ivory Coast, Malagasy Rep., Senegal, Tanzania, Upper Volta. North America: United States (Massachusetts, Michigan). Central America: Panama Canal. South America: Brazil. Asia: Burma, India (Ankola in Karnataka), Sri Lanka. Europe: Austria, Germany, Poland, Sweden, U.S.S.R. (Russian S.F.S.R., Ukrainian S.S.R.). Oceania: Australia (Queensland, Arnhem Land, New Caledonia). West Indies: Puerto Rico (Gonzalves 1981).

4. **Bulbochaete iyengarii** Sarma & Mukherjee (Pl. 1, Figs 6a, b; Pl. 2, Fig. 3)  
(Sarma and Mukherjee 1990, 55-57, 1: 1-7)

Macrandrous, heterothallic, vegetative cells moniliform to short cylindrical, 13.2-14.0 × 13.0-16.5 µm. Basal cell pointed at the base, basal cell blunt. Oogonium ellipsoid, brown, erect, 33 × 22 µm. Oospore of same shape as oogonium, normally completely filling the oogonium, oospore 30.0 × 19.8 µm in diameter, spore wall three-layered, outer layer smooth, median layer areolate. Antheridium erect, 1-2 seriate, 33 × 9 µm, division horizontal.

*Note:* This species resembles *B. macrandria* Ley (Gonzalves 1981, Mrozinska 1985) in its shape and size of the vegetative cell, but differs in basal cell. In this species basal cell is blunt, but in *B. macrandria* basal cell is conical; ornamentation of oospore in *B. iyengarii* is areolate, but scrobiculate in *B. macrandria*.

*Materials studied:* Col. No. Bulbo-004, 18 November 2000, Chagati Pond at Godagari, Rajshahi, filaments attached to *Nymphaea nouchali* Burm.; Col. No. Bulbo-013, 2 March 2005, *Andhasura beel* in Naogaon, filaments attached to *Nitella hyalina*.

*Distribution:* India (Rukni in Purulia District, Amtala in Murshidabad District) (Sarma and Mukherjee 1990).

5. **Bulbochaete keralense** Venk. and Natr. (Pl. 1, Figs 4a, b; Pl. 2, Fig. 9)  
(Gonzalves 1981, 646, 10: 70)

Nannandrous, idioandrosporous, vegetative cells cylindrical, 13.2-18.0 × 24-33 µm, division of suffultory cell basal. Oogonium depressed-globose, erect, situated below a terminal seta, 36.6-29.0 × 79-33 µm. Oospore is completely filling the oogonium, 29.7-33.0 × 26.4-29.0 µm, spore wall scrobiculate. Dwarf males situated on the suffultory cell near the oogonium or on the oogonium, 9.9-11.9 × 22.7-24.4 µm. Antheridium single or two, exterior, 8.0 × 7.8 µm.

*Material studied:* Col. No. Bulbo-060, 22 November 2002, Dargapara near Kakanhat at Godagari in Rajshahi, filaments attached to *Corchorus olitorius* L. and *Cyperus tagetiformis* Roxb.

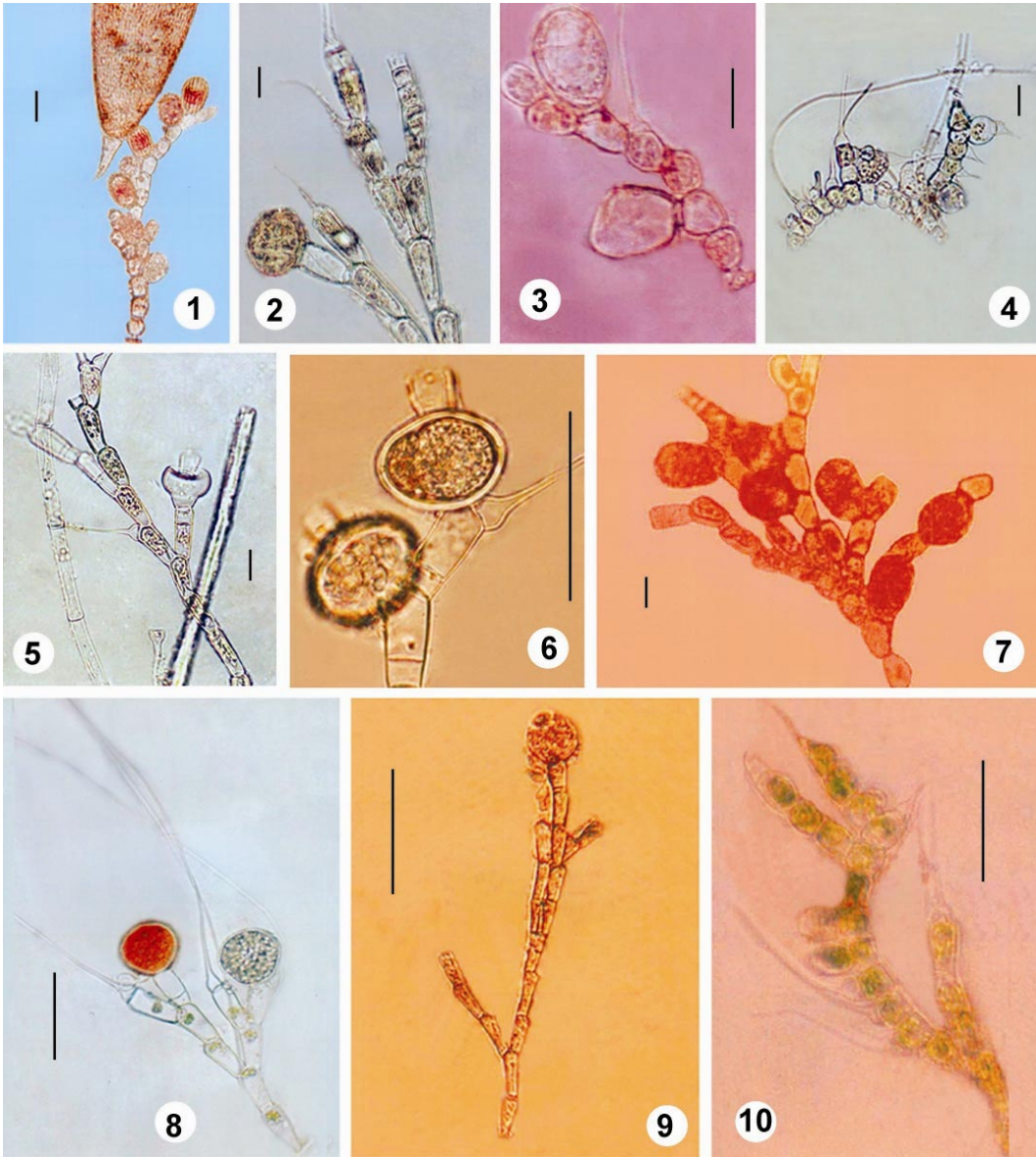
*Distribution:* India (Kottarakara in Kerala) (Gonzalves 1981).

6. **Bulbochaete minuta** West & West (Pl. 1, Fig. 7; Pl. 2, Fig. 8)  
(Gauthier-Lievre 1963-64, 240, 26: 42; Gonzalves 1981, 604, 10: 24)

Nannandrous, gynandrosporous, vegetative cells 9-13 × 16-26 µm, division of suffultory cell basal. Oogonium depressed-globose, erect or patent, situated below an androsporangium, 30 × 26 µm, division median or nearly so. Oospore depressed-globose, 27 × 25 µm, spore wall smooth. Androsporangium unicellular, epigynous. Dwarf males situated on suffultory cell, 7 × 16 µm, stipe curved. Antheridium unicellular, exterior.

*Note:* In *B. minuta* the dwarf male is situated on the suffultory cell, but in *B. suberecta* (Coll.) Tiff., dwarf male is situated on the oogonium.

*Material studied:* Col. No. Bulbo-027, 1 November 2001, Naogaon district in Sapahar at Mungroil, filaments attached to *Scirpus articulatus* (L.) Palla.



**Plate 2**

Figs 1-10. 1,7. *Bulbochaete debaryana*, 2. *B. elatior* var. *elatior*, 3. *B. iyengarii*, 4. *B. pygmaea* var. *erecta*, 5. *B. suberecta*, 6. *B. crassa*, 8. *B. minuta*, 9. *B. keralense*, 10. *B. nana* var. *chungkingensis*. (Scales = 50  $\mu$ m)

*Distribution:* Africa: Congo, Ivory Coast, Malagasy, Mali, Upper Volta. North America: United States (Florida, Massachusetts, Michigan, New England, Oklahoma). Asia: China, India (Devarayi in Karnataka), Sri Lanka (Gonzalves 1981).

7. **Bulbochaete nana** Wittr. var. **chungkingensis** Jao (Pl. 1, Fig. 2; Pl. 2, Fig. 10)  
(Gonzalves 1981, 592, 10: 8B)

Macrandrous, homothallic, vegetative cells  $13-14 \times 18-23 \mu\text{m}$ . Oogonium somewhat obovoid-ellipsoid, rarely ellipsoid, broader than that of the type,  $23 \times 33 \mu\text{m}$ . Antheridium smaller than that of the type,  $8-10 \times 4-6 \mu\text{m}$ . Outer layer of spore wall smooth; median layer longitudinally costae. Antheridium single or in twos, erect or scattered,  $7 \times 5 \mu\text{m}$ .

*Material studied:* Col. No. Bulbo-067, 15 December 2002, Devipur at Mahadebpur in Naogaon district, filaments attached to deep water paddy straw (*Oryza rufipogon* Griffiths).

*Distribution:* According to Mrozinska (1985) this variety has so far been reported only from China.

8. **Bulbochaete pygmaea** Pringsh. var. **erecta** Jao (Pl. 1, Fig. 5; Pl. 2, Fig. 4)  
(Gauthier-Lievre 1963-64, 225, 16: a-f; Gonzalves 1981, 621, 10: 45A)

Nannandrous, gynandrosporous, filaments short, usually less than ten-celled, unbranched or with one or two-celled branches, vegetative cells  $13 \times 11 \mu\text{m}$ , basal cell  $13 \times 16 \mu\text{m}$ . Division of suffultory cell lacking. Oogonium ellipsoid, erect, usually next to the basal cell, very rarely terminal or patent, below vegetative cells or setae,  $21-24 \times 33-36 \mu\text{m}$ . Oospore  $19-22 \times 30 \mu\text{m}$ ; presence of longitudinal ribs on spore wall. Androsporangia single or in twos, scattered,  $10 \times 3 \mu\text{m}$ . Dwarf male situated near the oogonium, stripe  $13 \times 20 \mu\text{m}$ . Antheridium exterior.

*Material studied:* Col. No. Bulbo-045, 2 November 2001, Chakla at Mahadebpur in Naogaon district, filaments attached to *Enhydra fluctuans* Lour.

*Distribution:* The United States (Massachusetts) (Gonzalves 1981, Mrozinska 1985).

9. **Bulbochaete suberecta** (Coll.) Tiff. (Pl. 1, Fig. 8; Pl. 2, Fig. 5)  
(Gonzalves 1981, 656, 10: 83)

Nannandrous, gynandrosporous, vegetative cells  $24-36 \times 10-13 \mu\text{m}$ , division of suffultory cell suprmedian to superior. Oogonium depressed-globose, usually erect, situated below an androsporangium,  $33 \times 29 \mu\text{m}$ , division median. Oospore  $30 \times 27 \mu\text{m}$ , spore wall finely scrobiculate. Androsporangium single, epigynous, dwarf male situated on the oogonium,  $16 \times 10 \mu\text{m}$ . Antheridium  $7 \times 9 \mu\text{m}$ .

*Material studied:* Col. No. Bulbo-025, 1 November 2001, Mohishdanga at Sapahar upazilla in Naogaon district, filaments attached to *Cyperus tagetiformis*.

*Distribution:* North America (Massachusetts) (Gonzalves 1981, Mrozinska 1985).

## References

- Aziz, A., Alam, J. and Islam, A.K.M. Nurul 1991. Studies on the members of Oedogoniales epiphytic on deepwater rice plants near Sonargaon, Bangladesh. Dhaka Univ. Stud. Part E **6**(2):119-123.
- Booton, G.C., Floyd, G.L. and Fuerst, P.A. 1998. Origins and affinities of the green algal Orders Chaetophorales and Oedogoniales based on 18S rRNA gene sequences. J. Phycol. **34**: 312-318.
- Gonzalves, F.A. 1981. Oedogoniales. ICAR. New Delhi, pp. 1-757.
- Gauthier-Lievre, L. 1963-64. Oedogoniaceae Africains. Nova Hedwigia **7**: 208-255.
- Hasan, M.A. 2000. Assessment of diversity of algal plants in Chalan beel in relation to physico-chemical conditions. Ph.D. Thesis, Rajshahi University, pp. 1-420.
- Islam, A.K.M. Nurul 1972. The genus *Bulbochaete* in Bangladesh. Bangladesh J. Bot. **1**(1&2): 1-12.
- Islam, A.K.M. Nurul 1979. Addition to the list of Oedogoniaceae from Bangladesh. Dacca Univ. Stud. B. **27**(1): 47-52.
- Islam, A.K.M. Nurul and Sarma, P. 1965. New and rare species and varieties of the Oedogoniales from Dacca District, East Pakistan. Pak. Jour. Biol. Agri. Sci. **8**(1):169-188.
- Mattox, K.R. and Stewart, K.D. 1984. A classification of the green algae: a concept based on comparative cytology. In: Irvine, D.E.G. and John, D.M. (eds), Systematics of the Green Algae, pp. 29-72. Academy Press, London.
- Mrozinska, T. 1985. Süßwasserflora von Mitteleuropa Chlorophyta VI Oedogoniophyceae Oedogoniales. VEB Gustav Fischer Verlag Jena, pp. 1-624.
- Sarma, P. and Mukherjee, D. 1990. A new species of macrandrous heterothallic *Bulbochaete* (*B. iyengarii* sp. nov.) from west Bengal, India. In: Rajarao, V.N. (ed.), Perspectives in Phycology, pp. 55-57. Today & Tomorrow's Printers & Publishers, New Delhi, India.
- Saito, E. and Yamagishi, T. 1973. Studies on some *Bulbochaete* and *Oedogonium* in the Alaskan, Canada and Greenland. Gen. Educ. Rev., Coll. Agr. & Vet. Med., Nihon Uni. **9**: 24-31.
- Zaman, M. 1991. Studies on the algal flora of Chalan-beel in relation to its physico-chemical conditions. Ph.D. Thesis, Rajshahi University, pp. 1-550.

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