

CYANOBACTERIA IN BIOLOGICAL CRUSTS ON SOIL AND SUB-AERIAL HABITATS FROM
DIFFERENT LOCATIONS OF EASTERN INDIA

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ABSTRACT

Thirteen species of Cyanobacteria species belonging to eight genera e.g. *Phormidium* (3), *Leptolyngbya* (1), *Calothrix* (1), *Anabaena* (2), *Nostoc* (3), *Scytonema* (1), *Fischerella* (1), *Westiellopsis* (1) were recorded in biological crusts from different sub-aerial habitats of Orissa and in the soil crust of NEHU campus, Shillong, Meghalaya.

INTRODUCTION

Biological crusts are generally formed by microorganisms, e.g. algae, cyanobacteria, fungi, lichen and sometimes bryophytes, which are closely associated with the substratum forming mat like structures (Belnap & al. 2001, Pattanaik & Adhikary 2005). Such crusts occur on a variety of substrata ranging from exposed rock to hot deserts, arid areas, forests soils and rice field (Adhikary & Sahu 2000, Johansen & Shubert 2001, Budel 2002). In soil crusts, activity of these organisms results in stabilization of the surfaces, reduction in erosion and retaining moisture thus providing suitable habitat for growth of higher plants (Johansen 1993). Little information is available on the composition of cyanobacterial communities in the biological crusts on various substrata, especially in the Indian subcontinent (Marathe & Kushaldas 1997, Venkataraman & al. 1974). Due to arid and semi-arid climatic conditions in an eastern region of India during most part of the year, blackish brown crusts are usually found in the upper millimeter of soil and on sub-aerial surfaces. The composition of cyanobacteria species in the crusts collected from different regions of Orissa state and Meghalaya has been reported here.

Crusts samples were collected from upper surfaces of soil as well as various sub-aerial habitats during dry seasons and were stored in pre-sterilized screw cap bottles and transported to laboratory for analysis. These crusts samples were wetted with sterile water and examined under light microscope. Within few hours of wetting, living filaments of cyanobacteria could be visualized, however, morphological features were not distinct basing on which identification could be made. So a pinch of crust material were transferred to BG-11 medium with or without combined nitrogen (Rippka & al. 1979) and to agar plates (1% w/v agar-agar in the same medium) and incubated at $25\pm 1^\circ\text{C}$ under continuous light from fluorescent tube in the intensity 7.5 WD sq m up to 60 days. The organisms appeared in an enriched culture were morphometrically analysed and identified following (Desikachary 1959). Microphotographs were taken in a Meiji ML-TH-05 trinocular microscope using Nikon coolpix camera. Voucher number was assigned to each sample together with date of collection and deposited at the Department of Botany, Utkal University.

SYSTEMATIC ACCOUNT

1. *Phormidium acutum* (Brühl & Biswas) Anagnostidis & Komárek (Pl. 1A).

Synonym : *Oscillatoria acuta* (Brühl) & Biswas ex Geitler 1923.

Desikachary, T. V. 1959, p. 240, pl. 39, fig. 5.

Trichome solitary, almost straight, not constricted at the cross wall, 4-7 μm broad, slightly attenuated toward sub-obtuse apex which is bent aside; cells 3-4.5 μm in long.

Collection site : Crust on tree trunk, Biswanathpur, Cuttack, Orissa (Voucher no. 81, Date: 29-01-2004).

2. *Phormidium ambiguum* Gomont (Pl. 1D).

Synonym : *Amphithrix amoena* Kützinger 1843; *Lyngbya bourrellyana* Compère 1974.

Desikachary, T. V. 1959, p. 266, pl. 45, fig. 6.

Thallus expanded, bright blue- green; filament flexuous; trichome slightly constricted at the cross walls; sheath thin; cells shorter than broad, 4-5.6 μm broad, 1.5-2.7 μm long, rarely granulated at the cross walls; end cell rounded.

Collection site : Soil crust, Patia, Bhubaneswar, Orissa (Voucher no. B-29, Date: 29-01-2004).

Reported from moist soil of paddy fields (Banerji 1938, Hazarika & al. 2001, Parukutty 1939, Parija & al. 1969, Mitra 1951, Rao 1936 & Singh & al. 1997c); brown soil crust, Salbani & Raniganj, Orissa; arid soil, Tiruchirappalli, Tamil Nadu & sandy soil, Goa (Tirkey & Adhikary 2006).

3. *Phormidium limosum* (Dillwyn) Silva (Pl. 1B).

Synonym : *Oscillatoria limosa* (Dillwyn) Agardh 1812.

Basionym : *Conferva limosa* Dillwyn.

Desikachary, T. V. 1959, p. 206, pl. 42, fig. 11.

Thallus deep green; filamentous, without sheath, granulated, showing typical oscillatory movement; end cell with thick outer membrane, cells broader than long, length 2.5-4 μm and broad 12.5-16.6 μm .

Collection site : Soil crust, bank of Rushikulya river, Ganjam, Orissa (Voucher no. 395, Date: 25-09-2004).

4. *Leptolyngbya tenuis* (Gomont) Anagnostidis & Komárek (Pl. 1C).

Synonym : *Phormidium tenue* (Meneghini) Gomont 1892; *Lyngbya comperei* Senna 1983.

Desikachary, T. V. 1959, p. 259, pl. 43, fig. 13.

Thallus pale blue green, thin; trichome straight or slightly bent; attenuated at the end, 1-2 μm broad, cell up to 3 times longer than broad, 2.5-5 μm long, end cell acute-conical.

Collection site : Soil crust, rice field, Jaypur, Koraput, Orissa (Voucher no. 312, Date: 29-05-2003).

5. *Calothrix clavata* West (Pl. 1E).

Desikachary, T. V. 1959, p. 543, pl. 114, fig. 2.

Filament single, slightly bent; sheath close to trichome, very thin, colourless; trichome slightly constricted at the cross walls, 5-5.5 μm broad at the base, in the middle 2-5 μm broad; heterocyst basal, single, hemispherical.

Collection site : soil crust, rice field, Maniakati, Ganjam, Orissa (Voucher no. 99, Date: 04-04-2003).

6. *Anabaena circinalis* Rabenhorst ex Bornet & Flahault (Pl. 1J).

Synonym : *Anabaena hassallii* (Kützinger) Wittrock 1882.

Desikachary, T. V. 1959, p. 414, pl. 77, fig. 2.

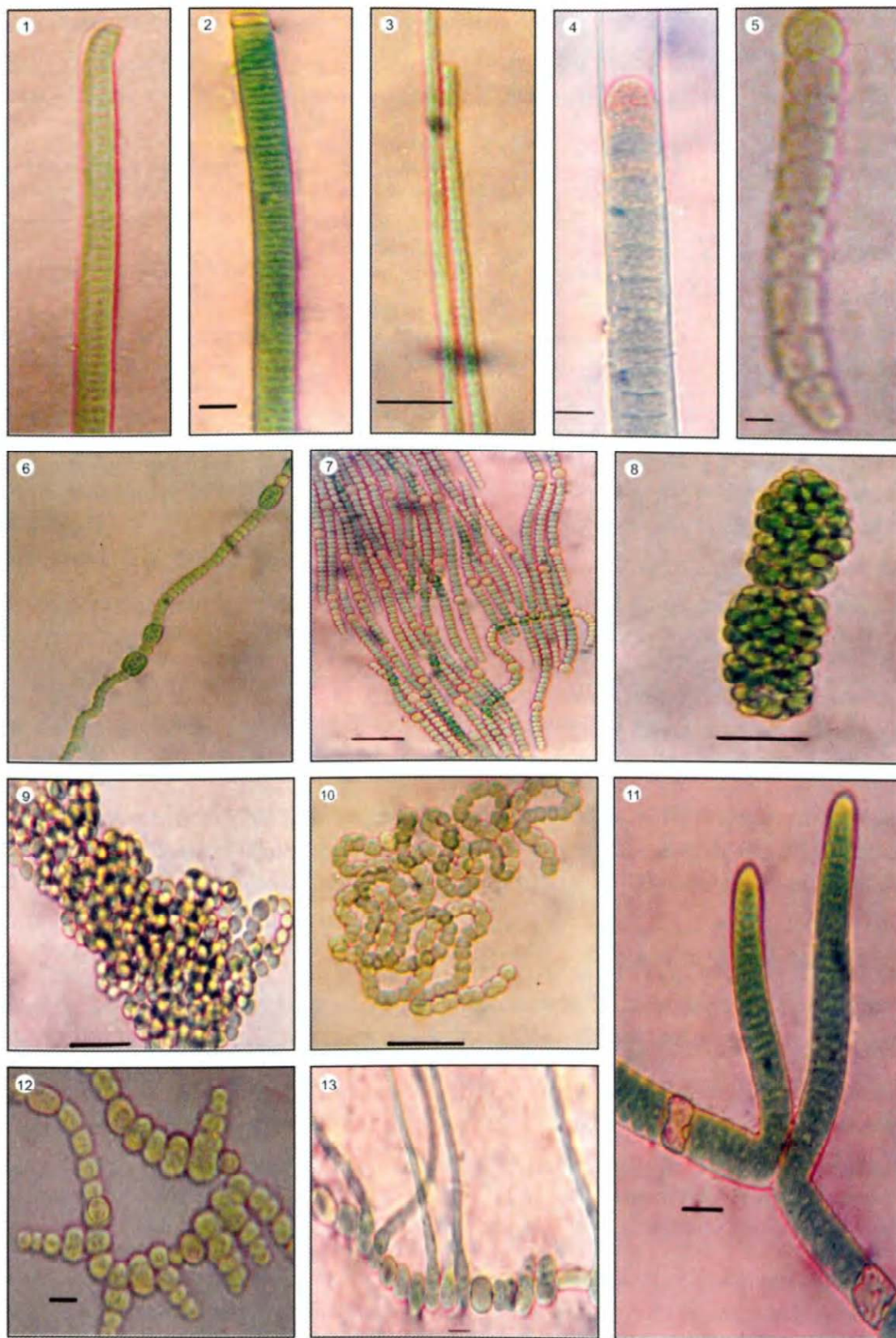


Plate. 1, A-M : **A.** *Phormidium acutum* (Brühl & Biswas) Anagnostidis & Komárek;
B. *Phormidium limosum* (Dillwyn) Silva; **C.** *Leptolyngbya tenuis* (Gomont) Anagnostidis & Komárek;
D. *Phormidium ambiguum* Gomont, **E.** *Calothrix clavata* West; **F.** *Anabaena torulosa* Lagerheim ex Bornet & Flahault; **G.** *Nostoc muscorum* (Agardh) ex Bornet & Flahault, **H.** *Nostoc punctiforme* (Kützinger) Hariot; **I.** *Nostoc commune* (Vaucher) Bornet & Flahault; **J.** *Anabaena circinalis* (Rabenhorst) ex Bornet & Flahault; **K.** *Scytonema stuposum* (Kützinger) Bornet & Flahault; **L.** *Fischerella tenuis* (Martens) Forti & **M.** *Westiellopsis prolifica* Janet.

Trichome single, spirally coiled; without sheath; 4.4-5.5 μm broad, cells barrel-shaped; heterocyst sub-spherical, 6.6-8 μm broad; end cell rounded.

Collection site : Crust on cemented wall, Jaypur, Koraput, Orissa (Voucher no. 313, Date: 25-09-2004).

Reported from soil crust, rice field, Nagaon, Assam (Ahmed 1999, 2001); paddy field soil, Jata, Kankandighi, West Bengal (Singh & al. 2001).

7. *Anabaena torulosa* Lagerheim ex Bornet & Flahault (Pl. 1F).

Desikachary, T. V. 1959, p. 415, pl. 71, fig. 6.

Thallus mucilaginous, thin; trichome 4.2-5 μm broad, apical cell acutely conical, cells barrel-shaped; heterocyst sub-spherical, spores on both side of the heterocyst, 6 μm broad and 6-10 μm long.

Collection site : Soil crust in rice field, Jaypur, Koraput, Orissa (Voucher no. 329, Date: 25-09-2004).

Reported from soil crust in rice field, Nagaon, Assam (Ahmed 1999, 2001); soil crust in rice field, Manipur (Amita Devi & al. 1999); rice field soil, Sihora, Jabalpur, Madhya Pradesh (Singh & al. 2000); laterite soil, Bhubaneswar, Orissa (Turkey & Adhikary 2006).

8. *Nostoc muscorum* Agardh ex Bornet & Flahault (Pl. 1G).

Synonym : *Nostoc muscorum* C. Agardh 1812.

Desikachary, T. V. 1959, p. 385, pl. 70, fig. 2.

Trichome less densely coiled, clearly visible; trichome 5.0-7.5 μm broad; cell barrel shaped, heterocyst nearly spherical, 6.6-8.3 μm broad, spores not seen.

Collection site : Soil crust, rice field, Jaypur, Koraput, Orissa (Voucher no. 312, Date: 25-09-2004).

Reported from soil crust in rice field, Nagaon, Assam (Ahmed 1999, 2001); soil crust in rice field, Manipur (Amita Devi & al. 1999); soil, rice field, Sihora, Jabalpur, Madhya Pradesh (Singh & al. 2000); moist soil of paddy field (Schmidle 1900); soil of paddy field, Kaoratala, Nagendrapur, West Bengal (Singh & al. 2001).

9. *Nostoc punctiforme* (Kützing) Hariot (Pl. 1H).

Synonym : *Nostoc hederulae* Meneghini 1849.

Desikachary, T. V. 1959, p. 374, pl. 69, fig. 1.

Filament flexuous, densely entangled; sheath delicate; trichome 3-4 μm broad, cell short barrel-shaped, bluish-green heterocyst 3.3-4.4 μm broad, spores sub-spherical 5-6.5 μm broad, thick and smooth.

Collection site : Crust on cemented wall, Maniakati, Ganjam, Orissa (Voucher no. 273, Date: 08-05-2004).

Reported from soil crust in rice field, Nagaon, Assam (Ahmed 1999, 2001); soil crust in rice field, Manipur (Amita Devi & al. 1999); soil crust, rice field, Baharaich, Uttar Pradesh (Mishra & al. 2001); soil in rice field, Durg, Chhattisgarh (Shrivastava 2000); soil of paddy field, Sarangabad, Canning, West Bengal (Singh & al. 2001); laterite soil, Bhubaneswar, Orissa, arid soil, Tiruchirappalli, Tamil Nadu, & sandy soil, Goa (Turkey & Adhikary 2006).

10. *Nostoc commune* Vaucher ex Bornet & Flahault (Pl. 1I).

Synonym : *Nostocella communis* (Vaucher) Gaillon; *Tremella nostoc* Linnaeus 1753; *Nostoc commune* Vaucher 1803; *Nostoc kurzianum* Zeller 1873.

Desikachary, T. V. 1959, p. 387, pl. 68, fig. 3.

Thallus brownish; filament coiled, densely entangled; cells 2.5-3.7 μm broad, 3.7-6.4 μm long; heterocyst at two different ends of the colony, sub-spherical to spherical, 5-7 μm diameter.

Collection site : Crust on cemented wall, Maniakati, Ganjam, Orissa (Voucher no. 273, Date: 08-05-2004).

Reported from soil crust in rice field, Nagaon, Assam (Ahmed 2001); soil crust in rice field, Manipur (Amita Devi & al. 1999); soil of paddy field, Kaoratala, Nagendrapur, West Bengal (Singh & al. 2001).

11. *Scytonema stuposum* (Kützing) Bornet & Flahault (Pl. 1K).

Desikachary, T. V. 1959, p. 459, pl. 93, fig. 4.

Thallus broadly expanded, greenish; filament 4-10 mm long, false branched; sheath thick, gelatinous; trichome olive violet, when dry greenish, 12-18 μm broad; cell 1/2-1/3 shorter than broad, sub quadrate; heterocyst 9.9-11.6 μm broad and 11.8-13.2 μm long.

Collection site : Soil crust, NEHU campus, Shillong, Meghalaya (Voucher no. 334, Date: 26-10-2004).

12. *Fischerella tenuis* (Martens) Forti (Pl. 1L).

Desikachary, T. V. 1959, p.602,

Thallus greenish, spongy, one side branching, heterocystous and branched, cells quadrate to rectangular, 4.6-7.5 μm broad, 5.2-6.5 μm long; heterocyst oval or cylindrical, 4.0-4.5 μm broad, 5.2-7.5 μm long.

Collection site : Crust on cemented wall, Maniakati, Ganjam, Orissa (Voucher no. 273, Date: 08-05-2004).

13. *Westiellopsis prolifica* Janet (Pl. 1M).

Desikachary, T. V. 1959, p. 596, pl. 131, fig. 4.

Thallus bluish green, spongy; filamentous, heterocyst, branched, lateral filaments are thinner than main branch, end with sporulated cells, 5.9-7.2 μm broad, 9.0-12.0 μm long; heterocysts intercalary, light yellow, cubical, cylindrical or oval, 5-5.9 μm broad, 9.5-10.9 μm long.

Collection site : Soil crust, rice field, Budhipada, Cuttack, Orissa (Voucher no. 78, Date: 29-01-2004).

Reported from soil crust in rice field, Nagaon, Assam (Ahmed 1999, 2001); soil crust in rice field, Manipur (Amita Devi & al. 1999); rice field soil, Terai belt, Baharaich, Uttar Pradesh (Mishra & al. 2001); laterite soil, Bhubaneswar, Orissa; brown forest soil, Salbani, Orissa and arid soil, Tiruchirappalli, Tamil Nadu (Tirkey & Adhikary 2006).

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पूर्वी भारत के विभिन्न अंचलों से मृदा एवं उप-वायवीय प्राकृतवासों पर जैव परपटी में साइनोबैक्टीरिया

एल.के. समद, एम. जेना एवं एस.पी. अधिकारी

आठ वंशों यथा-फॉर्मिडिअम (3), लेप्टोलिंगबिया (1), केलोथ्रिक्स (1), एनाबिना (2), नौस्टोक (3), साइटोनेमा (1), फिसरेला (1), वेस्टिलोप्सिस (1) के साइनोबैक्टीरिया की तेरह जातियों के उड़ीसा राज्य के विभिन्न उप-वायवीय प्राकृतवास एवं नेहू कैंपस, शिलांग, मेघालय के मृदा परपटी से अभिलेखन हुए।