



Occurrence of Cyanobacterial Flora (Nostocales) from Bhusawal City and its Adjoining Area, Maharashtra

J.S. Dhande

Department of Botany, Smt.P.K.Kotecha Mahila Mahavidyalaya, Bhusawal, Dist. Jalgaon, (M.S.) 425201

Abstract

Algae are natural inhabitants of water and serves as indicators of water quality in various ways. Sewage water contains 1-6 times more of organic matter which enhance the growth of algae. 48 members of Myxophytes collected from sewage water, moist soil near to sewage pools/puddles/nallies of Bhusawal city and its adjoining area. Present communication includes 18 taxa of genera like *Trichodesmium* Ehrenb., *Phormidium* Kuetz., *Lyngbya* Ag., *Anabaenopsis* (Wolosz.) Miller, *Nostoc* Vaucher, *Anabaena* Bory, *Raphidiopsis* Fritsch et Rich and *Tolypothrix* Kuetz.

Keywords: Algae, sewage, Bhusawal, and Myxophyceae.

Introduction

Bhusawal city and adjoining area located on a small tributary of river Tapi at latitude 21° 00'20.56" north and longitudes 76° 01'31.31" east. Bhusawal is a city as well as a municipal council in the Jalgaon district in the Indian state of Maharashtra and is the second biggest town in the district, situated on river Tapi and National Highway 6 passes through it. The population of Bhusawal in 2011 is 1,87,421. While in end of 2018 would be 2,15,948. There is no proper drainage facility in certain specifically in new area. The temperature ranges 18 -46° sometimes it lowest up to 9.5°, humidity 52-82 %, while rain fall is ranges 10mm-310mm.

Cyanophytes diverse group of prokaryotic phototrophs that are to be found in all possible aquatic habitats of the world. From available literature it is seems that vast amount of work has been carried out on Cyanobacteria from Maharashtra. Kamat, (1963); Thomas and Gonzalves, (1965); Vasishta, (1968); Ashtekar and Kamat, (1980); Sardesande and Goyal, (1981); Barhate and Tarar, (1983); Bhoge and Ragothaman, (1986); Mahajan and Mahajan, (1988); Kumawat and Jawale, (2001); Kumawat and Patil, (2010);

Kumawat and Borse, (2011); Patil, (2013); Kamble and Karande, (2014); Jain, (2015); Jaiswal, (2017); Valvi and Gautam, (2017); Jaiswal and Gavitt, (2019); Patil, *et al.*, (2021).

These genera of Nostocales from this region have not been studied earlier. This is the first ever attempt to explore, enumerate and taxonomically evaluate the algal components of the area.

Materials and Methods

The collections were made early in the morning between 7.00 to 9.00 am during July 2017- June 2019 from Bhusawal city and neighbourhood community. All the collected samples were studied fresh as far as possible and later preserved in 4 % formalin for further studies. Camera Lucida drawings were made with the help of mirror type of camera Lucida. The identification of taxa is based on the monograph Desikachary (1959 and relevant research paper publications. The material is deposited in the Department of Botany, Smt.P.K.Kotecha Mahila Mahavidyalaya, Bhusawal, district Jalgaon, (M.S.).

Observations and Results

Genus *Trichodesmium* Ehrenb., 1826

Trichodesmium erythraeum Ehrenberg ex Gomont -----**Fig. 1**

T.V. Desikachary, *Cyanophyta*, p.245-246, Pl 42, Fig. 1, 2, 1959.

Trichome free swimming, straight, constricted at the cross-walls, end walls gradually attenuated, 9.2-12.3 µm broad; cells nearly 1/2 as long as broad, 4.6-7.7 µm long, apex depressed conical or convex calyptra. (Coll. No. JSD138).

Habitat: On moist soil.

Genus *Phormidium* Kuetz., 1843

Phormidium tenue (Menegh.) Gomont-----**Fig. 2**

T.V. Desikachary, *Cyanophyta*, p.259, Pl. 43, Figs. 13-15, Pl. 44, Fig. 7-9, 1959.

Thallus pale blue-green, trichome straight or slightly bent, slightly constricted at cross-walls, attenuated ends, 1.5-2.7 µm broad; cells longer, up to 3 times longer than broad; 2.3-6.2 µm long, end cells acute, septa not granulated, cross-walls not commonly visible. (Coll. No. JSD 217).

Habitat: On moist soil, attached to plastic.

Genus *Lyngbya* Ag., 1824

Lyngbya polysiphoniae Frey-----**Fig. 3**

T.V. Desikachary, *Cyanophyta*, p.287, Pl. 53, Figs. 4,5, 1959.

Filament straight or curved, in bundle, epiphytic, trichome pale blue green, constricted at cross-walls, 2.2 µm broad; cells 1/2-1/3 as long as broad, 0.8-1.2 µm long, not capitate. (Coll. No. JSD217).

Habitat: Attached to plastic and wall of tank.

Genus *Anabaenopsis* (Wolosz.) Miller, 1923

Anabaenopsis circularis (West) Wolosz. et Mille-----**Fig. 4**

D.S. Agarkar, *J. Bombay Nat. Hist. Soc.*, 66(2):411, Figs. 1-3, 1969.

Trichome spirally coiled, 2.5-3.5 µm broad; cells spherical or subspherical and granulated, 1.2-3.8 µm long; heterocyst terminal, 3.4-4.1 µm broad. (Coll. No. JSD287).

Habitat: In small pond.

Genus *Nostoc* Vaucher, 1803

Nostoc commune Vaucher ex Born. et Flah.-----**Fig. 5**

T.V. Desikachary, *Cyanophyta*, p.387, Pl. 68, Fig. 3, 1959.

Thallus firm, gelatinous, expanded, later flattened, blue-green, filaments entangled, sheath distinct only at periphery; trichome 3.9-6.2 µm broad; barrel shaped, nearly spherical, nearly as same as broad, 3.1-6.9 µm long; heterocyst spherical, 6.9 µm broad, as big as vegetative cells. (Coll. No. JSD205).

Habitat: On moist soil, attached to grass.

Nostoc ellipsosporum (Desm.) Rabenh. ex Born. et Flah. f. *Minor* Prasad et al. -----**Fig. 6**

B.N. Prasad, R.K. Mehrotra and Yashpal Singh, *Geophytology*, 7 (2): 225-226, Fig. 4, 1977.

Thallus expanded, gelatinous, filaments entangled; trichomes 3.2-3.8 µm broad; cells spherical, oblong, 1.5-3.8 µm long; heterocyst intercalary, oblong, 4.6-6.2 µm broad, 6.9-7.7 µm long; hyaline. (Coll. No. JSD231).

Habitat: On moist and water logging soil.

Nostoc ellipsosporum (Desm.) Rabenh. ex Born. et Flah. var. *violacea* Rao, C.B. -----**Fig. 7**

T.V. Desikachary, *Cyanophyta*, pp.383-384, Pl. 68, Fig. 4, 1959.

Plant mass gelatinous, filaments flexuous, trichomes 2.3-3.8 µm broad, constricted at cross-walls; cells cylindrical, 2.3-5.8 µm long; spores ellipsoidal, cylindrical, 7.8-8.5 µm broad, 6.9-10.0 µm long with hyaline smooth outer walls. (Coll. No. JSD287).

Habitat: On moist soil.

Nostoc hatei Dixit----- **Fig. 8**

T.V. Desikachary *Cyanophyta*, p.389, Pl. 67, Fig. 2, 1959.

Thallus almost spherical, filaments densely entangled, sheath thin indistinct, hyaline; trichomes 3.8-4.6 µm broad, irregularly curved; cells spherical to ellipsoid or oblong, 1.9-3.8 µm long; heterocyst 5.4 µm broad, 6.2 µm long; spores not observed. (Coll. No. JSD183).

Habitat: In tank, stagnant water.

Nostoc piscinale Kuetz. ex Born. et Flah.-----**Fig. 9**

T.V. Desikachary, *Cyanophyta*, pp.377-378, Pl. 69, Fig. 3, 1959

Thallus variously tuberculate, mucilagenous or gelatinous, olive green, filaments flexuous,

loosely entangled, curved; trichomes 3.1-5.4 μm broad, cells spherical to rectangular, as long as broad, 3.5-5.4 μm long; heterocysts 4.6-6.2 μm broad, 5.4-6.2 μm long, spherical; spores not seen. (Coll. No. JSD205).

Habitat: On moist soil, attached grass among other algae.

Genus *Anabaena* Bory, 1822

Anabaena constricta (Szafer) Geitler -----

Fig. 10

C. Shaji and M.V.N. Panikkar, *Phykos*, 33 (1&2): 110, Fig. 24, 1994.

Thallus blue green, trichomes deeply constricted at cross-walls, cells 2.5-4.4 μm broad, ellipsoid, barrel shaped with rounded apices, 1.6-5.0 μm long; heterocyst single, intercalary, 4.4-6.2 μm broad, 3.7-6.6 μm long; spores not seen. (Coll. Nos. JSD177, JSD180, JSD271).

Habitat: Attached to plastic.

Anabaena fuellebornii Schmidle-----**Fig. 11**

T.V. Desikachary, *Cyanophyta*, pp.401, 403, Pl.71, Fig.11, Pl.75, Fig. 1,3, 1959.

Trichomes mucilaginous deeply constricted at the cross-walls, blue-green mass, straight, sheath diffluent; cells rectangular with rounded ends, 2.5-3.4 μm broad, some what longer then broad up to 3.7 μm long; heterocyst cylindrical or barrel shaped with rounded ends, 4.7 μm broad, 4.4 μm long; spores on either sides of heterocyst, ellipsoidal 5.3 μm broad, 8.7 μm long, yellowish with papillae. (Coll. No. JSD199).

It resembles more to taxon described by Desikachary, 1959 except in having smaller range of dimensions of trichomes, heterocyst and spore. (Trichome 4.5 μm broad, upto 10 μm long, heterocyst 7 μm broad, 10 (7-12) μm long; spores 10 (-16) μm broad and 20 (-34) μm long.

Habitat: In tank.

Anabaena laxa (Rabenh.) A. Br.----- **Fig. 12**

T.V. Desikachary, *Cyanophyta*, p.413, 1959.

Thallus attached to other algae or free floating, blue green, trichomes straight with mucilaginous sheath, 2.8-4.7 μm broad; cells

spherical barrel shaped, 1.7-5.0 μm long, end cells rounded or conical; heterocyst spherical or ellipsoid, 5.0-7.2 μm broad, 7.8-10 μm long, with a smooth and colourless outer wall. (Coll. Nos. JSD181, JSD182).

Habitat: On moist soil, stagnant water.

Anabaena naviculoides Fritsch-----**Fig. 13**

T.V. Desikachary, *Cyanophyta*, p.410, Pl. 72, Fig. 2, 1959.

Thallus thin, gelatinous, blue-green; trichomes elongate or straight, moniliform, apices acuminate, 2.8-4.7 μm broad, slightly tapering at the ends, apical cell conical; cells barrel -shaped, little longer or shorter than the broad, 1.7-5.0 μm long, heterocyst intercalary, 4.1-5.6 μm broad, 4.4-7.2 μm long; spores not seen. (Coll. Nos. JSD181, JSD182).

Habitat: On moist soil, attached to plastic.

Anabaena sphaerica Born. et Flah.-----**Fig. 14**

T.V. Desikachary, *Cyanophyta*, p.393, 1959.

Thallus blue green; trichomes straight, moniliform, 2.8-5.0 μm broad; cells spherical or short barrel shaped, 1.9-4.6 μm long, end cells rounded; heterocyst single, subspherical, 6.9 μm broad, 5.4 μm long; spores on both sides of heterocyst, subspherical to oval, 7.7 μm broad, 8.5-9.2 μm long, epispore smooth, yellowish. (Coll. No. JSD234).

The present taxon agrees in general with the plant described by Desikachary, 1959, except having smaller dimensions of spores (8-12 μm broad, 12-18 μm long).

Habitat: On moist soil, in roadside pool.

Anabaena volzii Lemm.----- **Fig. 15**

T.V. Desikachary, *Cyanophyta*, p.403, Pl. 77, Fig. 1, 1959.

Trichome single, straight or curved, constricted at cross-walls 2.5-3.8 μm broad; cells rectangular with rounded ends, 2.5-5.3 μm long, end cells rounded or conical; heterocyst single, nearly cylindrical, 5.0 μm broad, 9.6 μm long; spores not seen. (Coll. Nos. JSD182, JSD197).

In the present taxon cells are smaller and heterocyst shorter than the material described by Desikachary, 1959. Cells 4-5.5 μm broad, 7-

12 µm long, heterocyst 12-15 µm long.

Habitat: On moist soil, attached to plastic.

Habitat: In temporary pond.

Anabaena variabilis Kuetz.ex Born. et Flah.----

----- **Fig. 16**

T.V. Desikachary, *Cyanophyta*, pp.410-411, Pl. 71, Fig. 5, 1959.

Trichomes straight or curved, 2.3-3.8 µm broad; cells spherical or slightly barrel shaped, 2.3-4.6 µm long, end cells rounded; heterocyst spherical, 5.4 µm broad; spores are not seen. (Coll. No. JSD282).

Habitat: In tank and pool.

Genus *Raphidiopsis* Fritsch et Rich, 1929

Raphidiopsis indica Singh, R.N.----- **Fig. 17**

T.V. Desikachary, *Cyanophyta*, p.422, Pl. 79, Figs. 1,5, 1959.

Trichome single, curved, short, attenuated, constricted at cross-walls, ends pointed, 2.8-3.1 µm broad; cells 6-7 times as long as broad, with gas vacuoles, 14.1-21.8 µm long, spores not seen. (Coll. No. JSD199).

Habitat: In tank and pool..

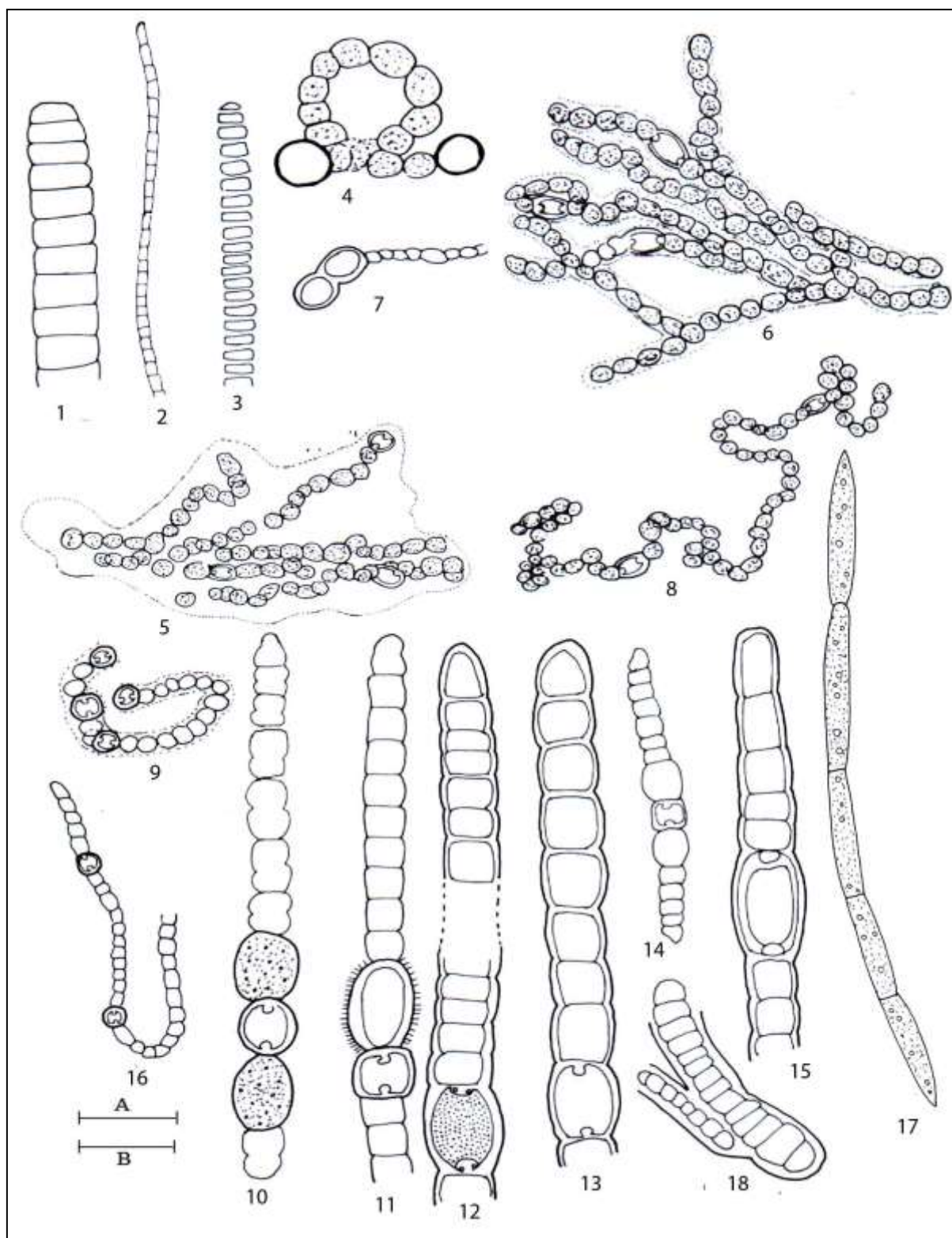
Genus *Tolypothrix* Kuetz., 1843

Tolypothrix distorta Kuetz. exborn. Et Flah. var. *penicillata* (Ag.) Lemm.-----**Fig. 18**

T.V. Desikachary, *Cyanophyta*, p.497, Pl. 102, Fig. 1, Pl. 102, Fig. 2, 1959.

Thallus cushion like, false branched, filaments 6.9-12.3 µm broad, colourless, trichome 6.2-10.0 µm broad; cells barrel shape to quadratic, 2.3-6.2 µm long; heterocyst single, cylindrical or spherical. (Coll. No. JSD294).

Habitat: In stagnant water and tank.



Conclusion

There are 01 species of each of *Trichodesmium* Ehrenb., *Phormidium* Kuetz., *Lyngbya* Ag., *Anabaenopsis* (Wolosz.) Miller, and *Raphidiopsis* Fritsch *et* Rich as well as 03 species, 01 variety, 01 forma of *Nostoc* Vaucher and 07 species of *Anabaena* Bory, 01 variety of *Tolypothrix* Kuetz.

has been recorded for the first time from the study area.

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Legends to Figures

1. *Trichodesmium erythraeum* Ehrenberg ex Gomont
2. *Phormidium tenue* (Menegh.) Gomont
3. *Lyngbya polysiphoniae* Fremy

4. *Anabaenopsis circularis* (West) Wolosz. et Miller
5. *Nostoc commune* Vaucher ex Born. et Flah.
6. *Nostoc ellipsosporum* (Desm.) Rabenh. ex Born. et Flah. f. *minor* Prasad et al.
7. *Nostoc ellipsosporum* (Desm.) Rabenh. ex Born. et Flah. var. *violacea* Rao, C.B.
8. *Nostoc hatei* Dixit
9. *Nostoc piscinale* Kuetz. ex Born. et Flah.
10. *Anabaena constricta* (Szafer) Geitler
11. *Anabaena fuellebornii* Schmidle
12. *Anabaena laxa* (Rabenh.) A. Br.
13. *Anabaena naviculoides* Fritsch
14. *Anabaena sphaerica* Born. et Flah.
15. *Anabaena volzii* Lemm.
16. *Anabaena variabilis* Kuetz. ex Born. et Flah.
17. *Raphidiopsis indica* Singh, R.N.
18. *Tolypothrix distorta* Kuetz. ex Born. et Flah. var. *penicillata* (Ag.) Lemm.

Scale bar A : 25 μ m

Scale bar B : 10 μ m

Scale A: Fig. 1,2,5,7,8,9,14,16,18

Scale B: Fig. 3,4,6,10 to 13,15,17

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