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Taxonomical investigation of chroococcales from Nandurbar District (MH) India

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Abstract
The term Biodiversity refers to the totality of Genus, Species and Ecosystem of the region. The group Cyanophyta is an extremely diverse group of prokaryotic organisms which make valuable contribution to soil fertility by fixing atmospheric nitrogen These have tremendous potential in environment management, A number of "floras" summarizing the known species of cyanophyta in particular regions have been published during the 20th centuries. For comparative account with previous work the present investigation was done. Systematic account and statistical analysis of genus and species of group cyanophyta was explored in present work. District Nandurbar selected for the investigation. The work was also done for seasonal variation, and addition of any new finding of species in light of biodiversity and various distribution of group Cyanophyta. In the present taxonomic survey total 20 species of group cyanophyta are reported, total 11 genera, 20 species, 02 varieties and 2 forma have been identified spread over the class Chroococcales of Cyanophyta. Based on the number of taxa the dominance of algal Genera is Aphanothece with 5 species *Gloeocapsa* with 04 species and *Aphanocapsa* with 2 species, *Merismopodia* with 02 species are recorded.

Keywords: Taxonomy, cyanophyta, chroococcales, nandurbar

Introduction
The word diversity means variety, diverseness, differences, variations among the individuals. The term Biodiversity refers to the totality of Genus, Species and ecosystem of the region. It is fact that all the species can occur at one place whether or not a species can occur on a site. It is determined by the environmental conditions of the site and the range of tolerance of the species. Cyanophyta is identified as the natural source potential to yield of the bioactive compound such as primary metabolites (like fatty acid, protein vitamins) secondary metabolites, antifungal, antibacterial, Antineoplastic and antitumor, sunscreen, exopolysaccharide, biopolyester, environmental bioremediation, biofuel and blue coloring pigment C-phycocyanin. This pigment also has diagnostic and pharmaceutical applications. In the absence of commercial production from India and the growing market demand for this pigment it is useful to screen new isolates of cyanobacteria for their potential to yield these valuable pigments. In phycology, the major contributions to Indian workers were made by Augustine (1971), Barhate and Tarar (1981) [2], Bhoge (1984), Bhoge and Ragothaman (1986), Chinnasamy M. (2007), Deore (1983), Desikachary (1959) [9], Jain (2015), Kamat (1963), Chaturvedi (1976), and Hdgde and Somanna (1991), Deore (1983), Bhoge (1984), Nandan (2004), There are few reports on taxonomic work of blue green algae from Satara district but majority of the work was restricted to taxonomy of blue green algae from paddy fields. Jaiswal (1993) while studying algal flora of the Nandurbar reported 14 taxa of cyanophyceae. Kemble P. et. al., (2014), Jain (2015), studied systematic account of *oscillatoria* species from sonvad dam and devbhane dam of Dhule. Few species are recorded on the algal flora of cyanophyta of district Nandurbar. The present investigation is the outcome of detailed of systematic studies of Chroococcales of Nandurbar district (Maharashtra). The taluka Navapur and Nandurbar from district Nandurbar is selected for systematic account of cyanophyta. The work was also done for seasonal variation, and addition of any new finding of species in light of biodiversity and various distribution of group Cyanophyta.. In the present taxonomic survey total 20 species of group cyanophyta are reported, total 11 genera, 20 species, 02 varieties and 2 forma have been identified spread over the class Chroococcales of Cyanophyta. Based on the number of taxa the dominance of algal Genera is Aphanothece with 5 species *Gloeocapsa* with 04 species and *Aphanocapsa* with 2 species, *Merismopodia* with 02 species are recorded.

Material and Methods
The taluka Navapur and Nandurbar from District Nandurbar is selected for Systematic account of Cyanophyta. Navapur taluka lies near the boundary of Gujarat state. Navapur Taluka is in Nandurbar District of Maharashtra, India. The algal collection were made at monthly interval from different places of taluka Navapur and Nandurbar The sampling sites were select carefully, so as to get maximum number of algal forms growing in the varied habitats. Another important aim of this method of selection is to correlate the species identification to the changes taking place in the habitats. All collections was preserved in 4% formalin for further Taxonomical investigation. Temporary and permanent preparations of slides were done during this work. Line drawings of different forms of algae were made by camera Lucida. The algae were identified by relevant monographs and recent available literature (Desikachary, 1959) [9].

Preparation of Semi-permanent Slides
A drop of glycerin formalin mountant (6 ml glycerin 10 ml of 40% formaldehyde + 84 ml of distilled water) was taken on slide, to which a drop of concentrated preserved sample was added and was covered by a cover slip of suitable size.

Morphological Description

1. *Gloeocapsa livida* (Carm.) Kutz. [Pl.1, Fig.1]

Desikachary T.V., 1959 [9], P. 116, Pl. 27, F. 8.
Kant S. and Gupta P., 1998, P. 41, Pl, 17, F. 18.
Thallus mucilaginous first rounded or lobed, later expanded, hyaline, greenish to olive brown in colour, cells small, with sheath 6.8 µ diam. and without sheath 3-4 µ diam., in colonies of 16-14 µ diam., sheath light bluish, hyaline, contents densely bluish green.
Observed diam. of cells 3.8 µ
Habitat: - From paddy field, (C).

2. *Gloeocapsa kuetzingiana* Nag. [Pl.1, Fig.2]

Desikachary T.V., 1959 [9], P. 118, Pl. 23, F. 4 and P, 24, F. 12.
Thallus thin, soft, brownish or blackish, cells densely aggregated in colonies up to 150 µ diam.; cells without sheath 3-4 µ diam., with sheath 4-7.5 µ diam., blue-green; sheath yellow to brown, not lamellated.
Observed cells without sheath 3-4 u in diam.; 5-6 µ in diam. with sheath.
Habitat: - In stagnant water. (VC).

3. *Gloeocapsa compacta* Kutz [Pl.1, Fig.3]

Desikachary T.V., 1959 [9], P. 121, Pl, 24, F. 7.
Thallus reddish brown, compact, cells without sheath mostly 2-2-.5 µ diam, blue-green, sheath unlamellated, dull reddish violet to colorless with many daughter colonies, sometimes a dull brownish firm individual envelope present, with envelope up to 3-5 µ diam. colonies up to 12-20µdiam.
Observed diam. l.9 µ.
Habitat: - Colony floating on a water surface. (A).

4. *Gleocapsa montana* Kutz [Pl.1, Fig.4]

Desikachary T.V., 1959 [9], p. 123.pl. 24, f 14
Thallus amorphous, broad, mucilaginous, pale yellowish, or light green in color, cells spherical or sub spherical, with sheath 4-10 µ broad and without sheath 2-5 µ broad, single or two together in colony, colony 13-28 µ broad, sheath lamellated, colorless, outer lamella diffluent, contents more or less opaque, homogeneous, finely granular, pale blue-green
Observed breadth of cell with sheath l0 µ, without sheath 5 µ, colony 20.8 µ broad.
Habitat: - On cement wall. (A).

5. *Gloeothece rupestris* (Lyngb.) Bornet. var. *tepidariorum* (A. Br.) Hansg. [Pl.1,Fig.5]

Gonzalves E.A and Kamat N.D, 1958, J. Uni. Bombay, 27(3), P, 28, Pl. l., F. 1
Cells ellipsoidal to cylindrical, light blue-green, sheath mucilaginous, hyaline, stratified. Lat. cell. 5.2 - 5.8 µ, long cell 6.5-9.7µ lat. cell. cum.veg, 9.7 -13 µ; long cell cum. veg., 13-16.2 µ. Observed cell 12 µ broad and 13µ long.
Habitat: - In small pond (VC).

6. *Aphanocapsa littoralis* Hansg.var. *macrococca* Hansg. [Pl.1, Fig.6]

Dixit S. C., 1936, Proc. Indian Acad. Sci. B., 3 (93), P. 95, F. 1.A
Desikachary T.V., 1959 [9], P. 131
Cells 4.5 - 10 µ diam.
Observed cells 8-10 µ in diam.
Habitat: - From compost (RC).

7. *Aphanocasa elachista* W et G. S. West [Pl.1, Fig.7]

Gonzalves E. A. and Kamat N. D., 1958, J Uni. Bombay, 27 (3), P.25, P1.1. F.5
Deikachary T.V., 1959; P. 132, Pl. 21, F. 5
Kant S and Gupta P, 1998, P 42, Pl 7, F 25
Colony small spherical or ellipsoidal, 26-38 µ in diam., mucilage thin, colorless, homogeneous, often diffluent, cells very loosely arranged single or in pairs, 1.5 - 18 µseldom up to 2 µ broad, blue-green.
Observed colony 40 µ in diam, cells 2.4 µbroad.
Habitat: - In staganent water (RC).

8. *Aphanothece caldariorm* Richer P [Pl.1, Fig.8]

Desikachary T.V., 1959 [9], P. 138, Pl. 9, F. 1.
Thallus slimy, often expanded, blue-green, grayish green or light violet, cells cylindrical, bow-shaped or sigmoid, sometimes straight, 1.8-3 µ broad, up to 12 µ long, mostly with a distinct often lamellated, colorless, individual membranes, at the ends of cells generally one ectoplasm present, cells blue, nannocytes through division of cells in three directions, often the entire thallus in a state of nannocytes formation
Observed length 12 µ; breadth 3.2 µ
Habitat: - On moist soil (C).

9. *Aphanothece conferta* Richter [l.2, Fig.9]

Desikachary T.V. 1959 [9], P. 140. Anand N., 1989, P. 24, F. 6.
Thallus gelatinous, membranous, expanded, dirty green or olive brown; cells single or in two's, oblong or spherical, 2.5 - 3 µ diam., 1 1/2 - 2 times as long as broad; sheath diffluent, colonies contents pale blue-green, granular.
Observed length 4 µ; breadth 3 µ.
Habitat: - Floating in pond near river. (C).

10. *Aphanothece nagelii* Wartm. [Pl.1, Fig.10]

Desikachary T.V., 1959 [9], P.141, Pl.22.F.7.
Kant S. and Gupta P., 1998; P 1.43.Pl. 17.F.27
Thallus gelatinous, yellow brown or olive green, cells oval, after division spherical, 3.5-4.5 x 6.5-8 µ in size, blue-green; sheath diffluent.
Observed diam. of cells 4.1 x 6 µ
Habitat: - Near stream. (RC)

11. *Aphanothece bullosa* (Menegh) Rabenh. [Pl.1,Fig.11]

Desikachary T.V., 1959 [9], P. 142. Pl.22.F.12
Thallus more or less spherical, irregularly lobed, up to 15 cm. diam., greenish to yellow, soft, cells long cylindrical, 3.5-5 µ broad, $1^{1/2}$- $2^{1/2}$ times as long, with or without individual envelopes, blue-green or olive green.
Observed cells 4-5 µ broad; 5-10 µ long.
Habitat: - On moist soil (A)

12. *Aphanothece microscopica* Nag. [Pl.1, Fig.12]

Desikachary T.V., 1959 [9], P. 142, Pl.22, F.4, 5, 9.
Prasad B.N., Srivastava M.N., and Khanna P, 1986, J. K. Indian. Bot. Soc, 65:326, F.6.
Thallus small, gelatinous, at first rounded later amorphous, up to 2 mm diam.; cells oblong cylindrical, more or less 4.5 µ broad, 1-2 times as long as broad, with some times distinct, individual sheath, blue green, colorless nanocytes present.
Observed length 14.5 µ; breadth 7.4 µ
Habitat: - Floating with other algae in a pool (A).

13. *Symechococcus cedrorum* Sauvageau. *syn. Cyanothece cedirorum* (Sauv.) Komarek [Pl.1, Fig.13]

Desikachary T.V., 1959 [9], P. 144.
Compere P., 1984; Hydrobiologia, 110, P.62, Pl. 1 F.2.
Cells single or two together, elongate, ellipsoidal, sometimes cylindrical and finely rounded, 3-4 µ broad, $1^{1/4}$ - 2 times as long as broad, 5-10 µ long, contents blue-green.
Observed cells 6.5 µ long; 3 µ broad
Habitat: - Free floating in water. (C)

14. *Synechocystis sallensis* Skuja form. indica Thomas et Gonzalves.* [Pl.1, Fig.14]

Thomas J. and Gonzalves E.A., 1965, Thermal algae of Western India, Hydrobiologia, 25, P.337, No.30.
Cells spherical, single or two together, 25-34 µ in diam., with a thin hyaline sheath.
Observed cell 27-31 µ in diameter.
Habitat: - On moist soil near stream bank. (VC)

15. *Rhabdoderma sigmoidea* N.Carter form *minor* N. Carter.* [Pl.1, Fig.15]

Gonzalves E.A. and Kamat N.D., 1958, J. Uni. Bombay, 27(3), P. 33, Pl.2, E.27.
Cells long straight or bent or S- shaped, rounded at the ends, blue-green Lat. cell 1.2 - 1.9 µ, long 3.2-9.6 µ.
Observed cell 1.2 µ broad; 4 µ long.
Habitat: - Floating in a road side ditch (A)

16. *Coelosphaerium dubium* Grunow [Pl.1, Fig16.]

Desikachary T.V. 1959 [9], P. 147; Pl. 28.F. 10, 11, 14, 15.
Colony spherical, up to 150 µ broad or irregular with 3-4 colonies, placed together, up to 300 µ diam., colonial mucilage firm, not lamellated up to 8 µ thick, cells spherical, closely arranged, 5 -7 µ broad, gas vacuoles present.
Observed colony 146 µ diam.; cells 7-10 µ thick; mucilage 4 µ thick.
Habitat: - On bark of *Azadirecta indica.* (VVR).

17. *Merismopedia convoluta* Breb. [Pl., Fig.17]

Desikachary T.V., 1959 [9], P. 152, Pl.29, F.8.12, 13.
Kant S. and Gupta P, 1998; P. 43; Pl 8, F. 10
Cells spherical to oblong, 4-5.2 µ broad, sometimes (8-) 9-11.7 µ long, rarely longer, forming a large 1-4 mm long and broad, flat often lea like convolute colonies, blue-green, olive green or yellowish.
Observed breadth of cells 4.5 µ, length 6 µ, 74.81 µ long and broad colonies.
Habitat: - In a stagnate water, near river. (VVR).

18. *Merismopedia tenuissima* Lemm. [Pl.1, Fig.18]

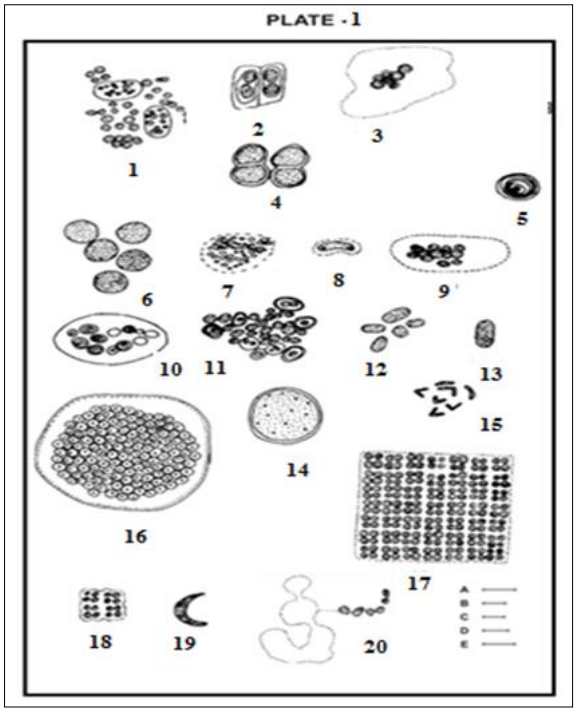
Desikachary T.V.; 1959 [9], P. 154, Pl.29, F.7 and Pl. 30, F, 8,9.
Cells pale blue-green closely packed in colonies of 16-100 cells, sub spherical, 1.3-2 µ broad, sometimes individual cells with distinct mucilaginous envelopes.
Observed colony (A) 124 celled, 1.5 µ broad, (B) 16 celled; 11 µ broad
Habitat: - Free floating in stagnant water (C)

19. *Dactylococcopsis raphidioides* Hansgirg. [Pl.1 Fig.19]

Desikachary T.V., 1959 [9]; P. 158, Pl. 29, F1, 2.
Cells spindle shaped, sigmoid or lanceolately bent, 1-3 µ broad, 5-6-8 times as long as broad, up to 25 µ long, light blue-green single to few together in a little mucilage.
Observed breadth 2.1 µ and length 10.4 µ.
Habitat: - Free floating in water pond. (C).

20. *Chloroglobea fritschi* Mitra. [Pl.1, Fig.20]

Mitra A.K., 1950, Two new algae from Indian soils; Ann. Bot., 14(56), P.400, F.25–43
Colony large, loosely and irregularly superposed, packets which are visible to the naked eye and consist of rounded chroococcoid cells of variable size. No mucilage envelop is recognizable around the individual packets, cells generally rounded, may become polygonal by mutual pressure.
Observed diam. 3.5 µ
Habitat: - Free floating. (R)



Conclusion

In the present taxonomic survey total 20 species of group cyanophyta are reported, total 11 genera, 20 species, 02 varieties and 2 forma have been identified spread over the class Chroococcales of Cyanophyta. Based on the number of taxa the dominance of algal Genera is Aphanothece with 5 species *Gloeocapsa* with 04 species and *Aphanocapsa* with 2 species, *Merismopodia* with 02 species are recorded. It is observed that *Coelosphaerium dubium*, *Merismopedia convolute* found very rarely.

Abbreviation

Sr. No.	Abbreviation	Full form
A	Quantative Abundance	
1	A	Abundant
2	VC	Very common
3	C	Common
4	RC	Rather common
5	RR	Rather rare
6	R	Rare
7	VR	Very rare
8	VVR	Very very rare

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