



OBSERVATIONS ON FILAMENTOUS BLUE GREEN ALGAE FROM SATARA DISTRICT, MAHARASHTRA, INDIA

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Aim of the present study was to assess biodiversity of filamentous blue green algae from Satara district. Species were collected from various localities within the study area and identified based on standard literature. In all 23 species belonging to 10 genera viz., *Spirulina*, *Oscillatoria*, *Microcoleus*, *Nostoc*, *Anabaena*, *Plectonema*, *Scytonema*, *Tolypothrix*, *Calothrix* and *Westiellopsis* within orders Nostocales and Stigonematales have been described. Among these 10 genera fourteen are heterocystous and nine are non heterocystous. Abundance of these filamentous blue green algae shows richness of filamentous forms within the study area. These species are being reported for the first time from the study area.

Key words: Blue Green Algae, Nostocales, Satara, Stigonematales.

Blue green algae represent the oxygenic prokaryotes among the microorganisms. Not only phycologists but even microbiologists world over are paying their attention towards these prokaryotes. Blue green algae rank first amongst the prokaryotic soil microflora of an area. The significance of blue green algal species as nitrogen fixers and soil binders have been well investigated by number of workers. Critical search of literature reveals that vast amount of work has been done on the taxonomy of the blue green algae from Maharashtra (Ashtekar and Kamat 1980, Barhate and Tarar 1983a, Bhoge and Ragotman 1986, Kamat 1962, 1963, 1964, 1968; Mahajan and Mahajan 1988, 1989, Sardeshpande. and Goyal 1981). However scanty information is available with us regarding the blue green algae from Western Maharashtra and specially Satara district (Ghadge and Karande 2008).

Satara district lies between 17° 50' and 18° 11' North latitude and 73° 31' and 74° 75' East longitude along the Sahyadri ranges in Maharashtra state. It has an area of 10417 sq. km., with 11 administrative tahsils. The district has a compact shape with an east west stretch of about 144 km., and north south about 120 km. Average maximum temperature of district is 37.5°C and minimum is 11.6°C. Average annual rainfall of district is 1420 mm. Residual hill ranges and the intermediate valleys, all well developed on a tableland surface, form the main element of landscape in the district. Several leading spurs pass east and southeast from the Sahyadris. Within limits of these hill ranges there are several hills and hill forts. The eastern region constitutes dry and plain land. Because of these geographical features the district enjoys all

extremes of nature.

MATERIALS AND METHODS

For the present study collections were made from various localities within district from August 2008 to December 2009. Specimens were collected from temporary pools, puddles, water reservoirs, paddy fields and other such localities. Cultures were also raised to isolate some prominent forms. Identification was made based on work of Desikachary (1959) and Ripka (1979).

OBSERVATIONS

1. *Spirulina subsalsa* Oerst. ex Gomont Desikachary 1959, pp. 193; Pl.36, fig. 3,9 Pl. 1, Fig. 1

Trichome 1.1-1.8 µm broad, blue-green, densely spirally coiled, regularly, loosely coiled, forming a bright blue-green thallus among other algae spirals very close to each other, 4-5 µm broad.

Habitat: Pond.

Location: Kas

2. *Oscillatoria sancta* (Kutz.) Gomont Desikachary 1959, pp. 203; Pl.42, fig. 10 Pl. 1, Fig. 2

Thallus dark blue, shining, thin, gelatinous. Trichome straight distinctly constricted at the cross walls 12-15 µm broad, dull blue-green. Cells 1/5 times as long as broad, granulated at the cross walls. End cell flattened, hemispherical, slightly capitate, with thickened membrane.

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Habitat: On wet soil and floating in stagnant water.

Location: Petri, Andheri Kas, Bamnoli.

3. *Oscillatoria obscura* Bruhl et Biswas

Desikachary 1959, pp. 207

Pl. 1, Fig. 3

Trichome 5-6 μm broad, attenuated at apex, round, straight, blue-green unconstructed at cross walls, cells about 1/5 as long as broad, cross walls granulated.

Habitat: Ditches.

Location: Falani, Andheri Kas, Kas

4. *Oscillatoria subbrevis* Schmidle

Desikachary 1959, pp. 207; Pl.37, fig. 2 and Pl. 40, fig. 1

Pl. 1, Fig. 4

Trichome single, attenuated at apices. Cells 1.3-1.5 μm long, not granulated at cross walls, end cell rounded, calyptras absent.

Habitat: Wet banks of lake.

Location: Petri, Yevateshwar, Bamnoli.

5. *Oscillatoria curviceps* Ag.ex. Gomont

Desikachary 1959, pp. 209; Pl.38, fig. 2

Pl. 1, Fig. 5

Thallus dark blue-green, trichomes straight, not attenuated, not constricted at cross walls, 12-15 μm broad, cells 1/3-1/6 as long as broad 2-4 μm long cross walls granulated, end cells flat rounded not capitate.

Habitat: On wet soil

Location: Yevateshwar

6. *Oscillatoria princeps* Vaucher ex Gomont

Desikachary 1959, pp. 210; Pl.37, fig. 1, 10, 11, 13, 14

Pl. 1, Fig. 6

Trichome blue green, forming as thallus, straight not constricted at cross wall, 13-16 μm broad, blue-green, straightly attenuated at the apices and bent, cells 1/11-1/4 as long as broad, 3.5-4.5 μm long, end cells flatly rounded, slightly capitate with slightly thickened membrane.

Habitat: On moist soil

Location: Andheri, Kas, Bamnoli

7. *Oscillatoria amoena* (Kutz.) Gomont

Desikachary 1959, pp. 230; Pl.40, fig. 12

Pl. 1, Fig. 7

Thallus blue green, trichome straight slightly constricted at the cross walls, ends gradually attenuated, 2.5-3.2 μm broad, cells nearly as long as broad, 2.5-4 μm long, septa granulated, end cells capitate, broadly conical with calyptra.

Habitat: Wet soil

Location: Limb, Falani.

8. *Oscillatoria okeni* Ag. ex Gomont

Desikachary 1959, pp. 231; Pl.38, fig. 17

Pl. 1, Fig. 8

Thallus dull blue green, trichome straight, fragile distinctly constricted at cross walls, 5.5-7 μm broad, at the ends gradually attenuated, undulating, slightly bent, cells 1/3 as long as broad 2.7-3.2 μm long at the end up to 8 μm long, end cells obtuse, not capitates without calyptra.

Habitat: Wet soil

Location: Andheri Kas, Kas, Yevateshwar.

9. *Microcoleus vaginatus* (Vaucher) Gomont

Desikachary 1959, pp. 343; Pl.56, fig. 3

Pl. 1, Fig. 9

Filaments single, creeping or forming a dark green thallus, coiled, sometimes sparsely branched, sheath colourless, uneven, sometimes gelatinizing, may often agglutinated with one another attenuated at the ends; cells 3.5-4.5 μm broad, cells 6-7.5 μm long, often granulated at cross walls, not constricted, dirty green; end cells capitate, with a flat conical calyptras.

Habitat: Wet soil

Location: Morawale

10. *Nostoc muscorum* Ag. ex Born. et Flah.

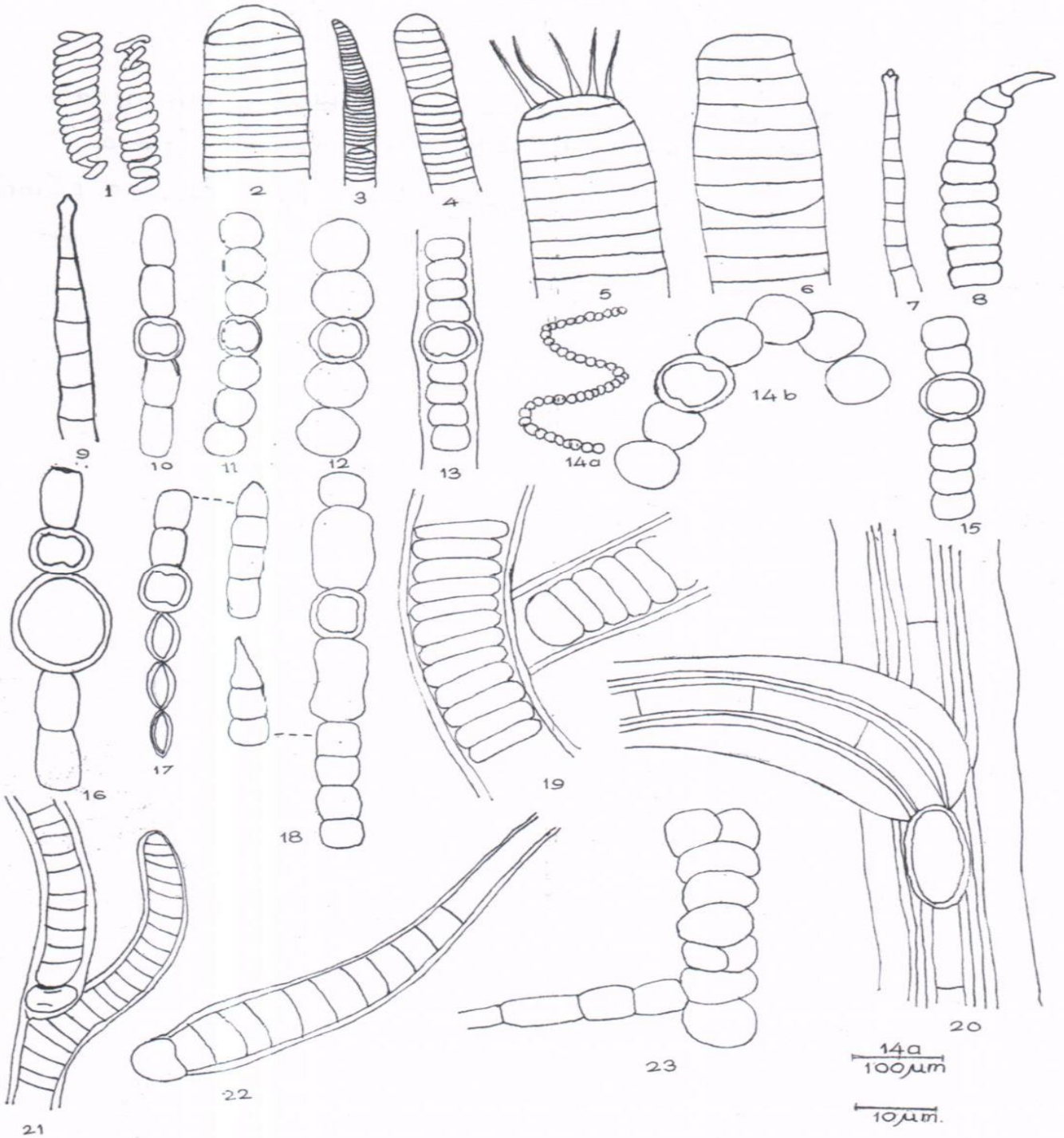
Desikachary 1959, pp. 385; Pl.70, fig. 2

Pl. 1, Fig. 10

Thallus gelatinous-membranous, irregularly expanded attached by lower surface, tuberculate, brown, nearly 2.5 μm in diameter, filaments densely entangled, sheath distinct only at the periphery of the thallus, yellowish brown, trichome 4-5 μm broad. Cell short-barrel shaped to cylindrical up to twice as long as

Plate 1 . Figures 1-23 :

1. *Spirulina subsalsa* Oerst. ex Gomont; 2. *Oscillatoria sancta* (Kutz.) Gomont ; 3. *Oscillatoria obscura* Bruhl et Biswas ; 4. *Oscillatoria subbrevis* Schmidle; 5. *Oscillatoria curviceps* Ag.ex. Gomont; 6. *Oscillatoria princeps* Vaucher ex Gomont; 7. *Oscillatoria amoena* (Kutz.) Gomont ; 8. *Oscillatoria okeni* Ag. ex Gomont; 9. *Microcoleus vaginatus* (Vaucher) Gomont ; 10. *Nostoc muscorum* Ag. ex Born.et Flah; 11. *Nostoc commune* Vaucher ex Born. et Flah;12. *Nostoc microscopicum* Carm. ex Born. et Flah 13. *Nostoc parmelioides* Kutz. ex Born. et Flah.; 14. *Anabaena spiroides* Klebahn; 15. *Anabaena fertilissima* Rao, C. B.;16. *Anabaena aphanizomenoides* Forti ; 17. *Anabaena doliolum* Bharadwaja; 18. *Anabaena torulosa* (Carm.) Lagerh. Ex Born. et Flah. ; 9. *Plectonema radiosum* (Schiederm.) Gomont. ; 20. *Scytonema amplum* West et west ; 21. *Tolypothrix fragilis* (Gardner) Geitler 22. *Calothrix braunii* (A.Br.) Bornet et Flah. ; 23. *Westiellopsis prolifica* Janet ;



broad, heterocyst nearly spherical, 7 μm broad.

Habitat : On soil

Location: Kas, Petri

11. *Nostoc commune* Vaucher ex Born. et Flah.
Desikachary 1959, pp. 387; Pl.68, fig. 3
Pl. 1, Fig. 11

Thallus firm gelatinous, expanding, undulated, leathery, irregularly torn, many centimeters diameter, blue-green, filaments flexuous, entangled, sheath mostly distinct only at periphery, thick yellowish brown, trichome 5-6 μm m broad, cell short nearly spherical; heterocyst spherical about 7 μm broad.

Habitat: On moist soils and rocks near water bodies.

Location: Kas, Yevateshwar

12. *Nostoc microscopicum* Carm. ex Born. et Flah
Desikachary 1959, pp. 387, 388
Pl. 1, Fig. 12

Thallus spherical, about 1cm in diameter soft but with firm outer surface, filaments loosely entangled, sheath distinct, yellowish, trichome 5-6 μm m broad, blue-green, cells sub-spherical, heterocyst nearly spherical 7 μm m broad.

Habitat: On moist rocks of fort and epiphytic on mosses and small angiosperms.

Location: Petri, Ajiankyatara, Mahabaleshwar.

13. *Nostoc parmelioides* Kutz. ex Born. et Flah.
Desikachary 1959, pp. 389; Pl.70, fig. 3
Pl. 1, Fig. 13

Thallus discoid, hard, attached, with a firm outer layer, up to 3 cm diam.; filaments radiating from a centre, nearly parallel in the middle, densely entangled at the periphery, sheath distinct, mostly at periphery, yellow, inside hyaline and diffluent trichome 4-4.5 μm broad, cell short barrel shaped, subspherical, heterocyst spherical 5.5-6 μm broad.

Habitat: Wet soil.

Location: Falani

14. *Anabaena spiroides* Klebahn

Desikachary 1959, pp. 395; Pl.71, fig. 9
Pl. 1, Fig. 14a, 14b

Trichome single, free, floating, regularly spirally

coiled with thick and mucilaginous sheath, spirals 52-54 μm broad and 45-50 μm distant; cells spherical, 7-8 μm broad mostly shorter than broad, with gas-vacuoles; heterocysts subspherical, 7 μm broad; spores next to the heterocysts, 12-14 μm broad.

Habitat: Pond

Location: Kas, Yevateshwar.

15. *Anabaena fertilissima* Rao, C. B.

Desikachary 1959, pp. 398; Pl.74, fig. 1
Pl. 1, Fig. 15

Trichome single, straight, with rounded end cells, up to 350 μm long, 5.2-5.6 μm broad, at apex 4 μm broad; cells barrel shaped 7-8 μm long; heterocyst almost spherical 7-8.5 μm ; spore in long chain, adjoining the heterocyst but formed centrifugally almost spherical, with a smooth hyaline outer wall, 5-8 μm broad and 3.2-4 μm long.

Habitat: Pond

Location: Kas, Yevateshwar, Limb.

16. *Anabaena aphanizomenoides* Forti

Desikachary 1959, pp. 405; Pl.71, fig. 4
Pl. 1, Fig. 16

Trichome single, straight 1.2mm long, 4-5 μm broad, slightly constricted at the cross wall; cells barrel-shaped, cylindrical, 1-3 times as long as broad 4-5 μm broad and 5-6 μm long with gas-vacuoles; heterocysts subspherical, 5.5-6 μm broad and 6.5-7.5 μm long, spores single near heterocysts, ellipsoid, 12-15 μm broad with smooth colourless wall.

Habitat: Pond

Location: Nahibe Ambeghar, Shirsinge.

17. *Anabaena doliolum* Bharadwaja

Desikachary 1959, pp. 410; Pl.78, fig. 3
Pl. 1, Fig. 17

Plant mass mucilaginous, pale blue-green; trichome single, free swimming, straight, curved, 4-4.5 μm m broad slightly tapering at the ends, with conical apical cell, cells barrel shaped as long as broad, heterocyst barrel shaped 5.2-6 μm broad, 6.5-7 μm long, spores ellipsoidal, with almost pointed apices in short or long chains, adjoining the heterocysts but develop centrifugally, epispore smooth and hyaline 4.2-5 μm

broad and 6.5-7.5µm long.

Habitat: Pond

Location: Kas, Yevteshwar

18. *Anabaena torulosa* (Carm.) Lagerh. Ex Born. et Flah.

Desikachary 1959, pp. 415; Pl.71, fig. 6 Pl. 1, Fig. 18

Thallus mucilaginous, thin blue-green, trichome 4.2-4.5µm broad, apical cell acutely conical, cells barrel shaped, as long as broad. Heterocyst sub-spherical; 6µm broad and 8-10µm long; spores on both sides of the heterocysts, single subcylindrical with rounded ends, up to twice as long as broad.

Habitat: Floating in pond.

Location: Kas, Yevateshwar, Bamnoli, Petri

19. *Plectonema radiosum* (Schiederm.) Gomont.

Desikachary 1959, pp. 437, 438; Pl.83, fig. 6, 8 Pl. 1, Fig. 19

Filaments irregularly curved, radially arranged in thallus, thallus caespitose, cushion like rounded about 1/2cm long dull green, richly false branching, single, sheath in the lower part of filament, thick, outside uneven, golden yellow and in upper part thin, hyaline. Cells mostly of upper part of trichome distinctly constricted at cross walls, 14-16 µm broad, 2.5-3µm long, blue-green, cross walls seldom granulated; end cell rounded.

Habitat: Wet soil.

Location: Yevateshwar

20. *Scytonema amplum* West et west

Desikachary 1959, pp. 469; Pl.89, fig. 4 Pl. 1, Fig. 20

Thallus small, wrinkled 3.5mm diameter, brownish, filaments densely intricate, 20-23 µm broad, false branches sparse, generally single 14-14.5 µm diameter narrower than the main filament sheath broad with parallel lamellation, on the outside gelatinous trichome 3.8 to 4.5 µm broad yellowish-green, apices broad, cells short cell twice as long as broad, heterocyst oblong, 3 times as long as broad.

Habitat: On moist rocks of waterfall

Location: Kas

21. *Tolypothrix fragilis* (Gardner) Geitler

Desikachary 1959, pp. 500; Pl.103, fig. 4 Pl. 1, Fig. 21

Filaments 6.5-7 µm broad, short straight, forming a thin thallus, sheath colourless not lamellated, at the bottom of the branch, trichome 5.5-6.5 µm broad, not constricted at the cross walls, cells in the older parts of the trichome as long as broad heterocyst spherical.

Habitat: On wall.

Location: Yevateshwar, Andheri Kas, Mahabaleshwar

22. *Calothrix braunii* (A.Br.) Bornet et Flah.

Desikachary 1959, pp. 535; Pl.1147, fig. 3 Pl. 1, Fig. 22

Thallus caespitose, blue-green or brownish, filaments straight parallel, 500 µm long, 9.5-10 µm broad, swollen at the base, slightly bent, sheath thin, close to trichome, colourless, trichome 6.5-7.2 µm broad, ending in long hair, constricted at the cross walls; cells shorter than broad; heterocysts basal, hemispherical.

Habitat: Wet soil

Location: Morawale

23. *Westiellopsis prolifica* Janet

Desikachary 1959, pp. 596; Pl.131, fig. 1-12 Pl. 1, Fig. 23

Thallus filamentous, heterocysts intercalary, filaments torulose, with short barrel shaped cells, 10-12 µm broad as long as broad or slightly longer, branch filaments thinner and elongate, not constricted at the cross walls, with elongate cylindrical cells, cells 4-6 µm broad, heterocysts oblong-cylindrical, 5.6-6 µm broad and 10.5-22 µm long.

Habitat: Wet soil

Location: Falani

RESULT AND DISCUSSION

Present investigation reveals observations on filamentous blue green algae collected within Satara district. Author could collect and identify 23 species belong-

ing to 10 genera. Classification of blue green algae as proposed by Desikachary (1959) emphasizes morphological observations, in which cyanophyta have been divided into five orders based on thallus organization. Except Chroococcales all the four viz., Stigonematales, Nostocales, Pleurocapsales include filamentous forms. In the study area species from only two orders viz. Nostocales and Stigonematales have been reported during investigation. Twenty three species belonging to ten genera viz., *Spirulina*, *Oscillatoria*, *Microcoleus*, *Nostoc*, *Anabaena* *Plectonema*, *Scytonema*, *Tolypothrix*, *Calothrix* and *Westiellopsis* have been documented. Maximum species of *Oscillatoria* (7), *Anabaena* (5) followed by *Nostoc* (4) and remaining seven genera represented by single species have been recorded during the study period. Out of these 23 species fourteen are heterocystous and nine are non-heterocystous. The localities screened mostly belonged to western hilly parts of the district. The eastern part of the district is dry and drought prone. Three species of genera *Nostoc*, *Oscillatoria* and *Tolypothrix* only were collected from that area. Our observations are close to those made in a project report-“Cyanobacterial biodiversity in paddy fields from Satara district”, submitted by Karande C. T. (2009) to UGC.

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