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Study on algae producing mucilage on soil surface in north Maharashtra

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ABSTRACT

Algae, other than aquatic habitats, do occur on soil surfaces in moisture-rich conditions. Cyanophycean members grow commonly on soil surfaces during rainy season. They produce brown black, deep green and olive green mucilage on top of soils. A study was done on such mucilage forming algae in which 14 taxa of non-heterocystous Cyanophyceae belonging to genera *Microcystis* and *Chroococcus* were very commonly observed from different habitats of north Maharashtra.

Keywords: Algae; Cyanophyceae; mucilage; soil surface

INTRODUCTION

Cyanophycean algae are characteristically covered by mucilage sheath and thus are responsible for producing thin or thick film of mucilage on soil surfaces. The soil algae, being component of soil ecosystem, play important role in changing soil properties. The reports on aquatic algae of many water bodies are well studied but soil inhabiting algae have been less explored in relation to taxonomy. Earlier, in Maharashtra, soil algae were studied by some workers in relation to different aspects. Availability of sporadic reports on soil algae with long gap in literature survey indicates that less attention has been given to soil algae. Marathe and Khushaldas (1975) worked on algal crust from Nagpur, Maharashtra and found that algal crust increased nitrogen, phosphorus, potassium and organic matter in soil along with increasing moisture content. A total of 47 species under 29 genera, belonging to Chlorophyceae, Bacillariophyceae and Cyanophyceae were recorded in maize field soil of Shrirampur Tehsil area of Ahmednagar district, Maharashtra (Jadhav er al 2019). Mahajan and Mahajan (1994) studied Cyanophyceae flora from cultivated soils and presented only checklist of various taxa for this. They worked on four crop fields of banana, jowar, cotton and wheat of Jalgaon, Maharashtra. Nandan (2004) worked on eco-biodiversity of soil algae of certain areas of Khandesh, Maharashtra with respect to diversity of colonial and filamentous taxa. Chaudhari et al (2007) studied 23 taxa from paddy field algae, particularly, filamentous members of family Nostocaceae, which are known as nitrogen fixing Cyanophycean algae. Recently, Chaudhari (2020, 2022) worked on scum forming Cyanophyceae of Bori dam and some surface growing heterocystous filamentous soil Cyanophyceae of north Maharashtra along with their taxonomy. The present report on mucilage producing algae comprises various habitats from north Maharashtra region. It primarily includes districts like Dhule, Nandurbar and Jalgaon of the state. The study was focused on to explore and record colonial, unicellular, non-heterocystous members of Cyanophyceae forming patches of mucilage on soil surface layers.

MATERIAL and METHODS

Mucilage forming algae were collected from different habitats during rainy season (Plate 1). Moist and marshy places were selected for field collection during the period 2017 to 2019. Algal stratum with mucilage was scrapped from soil surface and preserved in 4 per cent formalin for microscopic observations. Line drawings (Figs 1-14) were made with camera lucida and taxa were identified as per Desikachary (1959) and related literature.

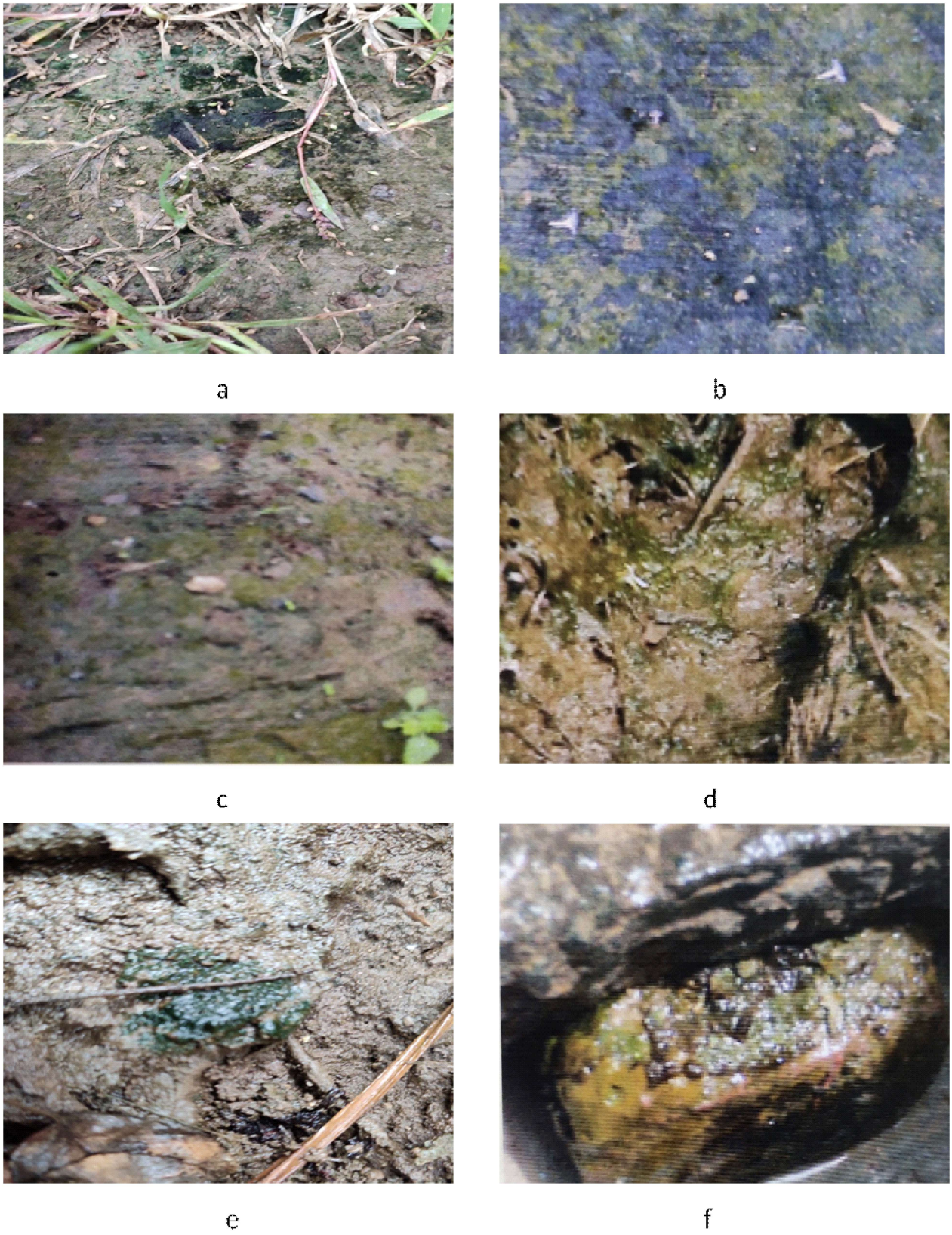
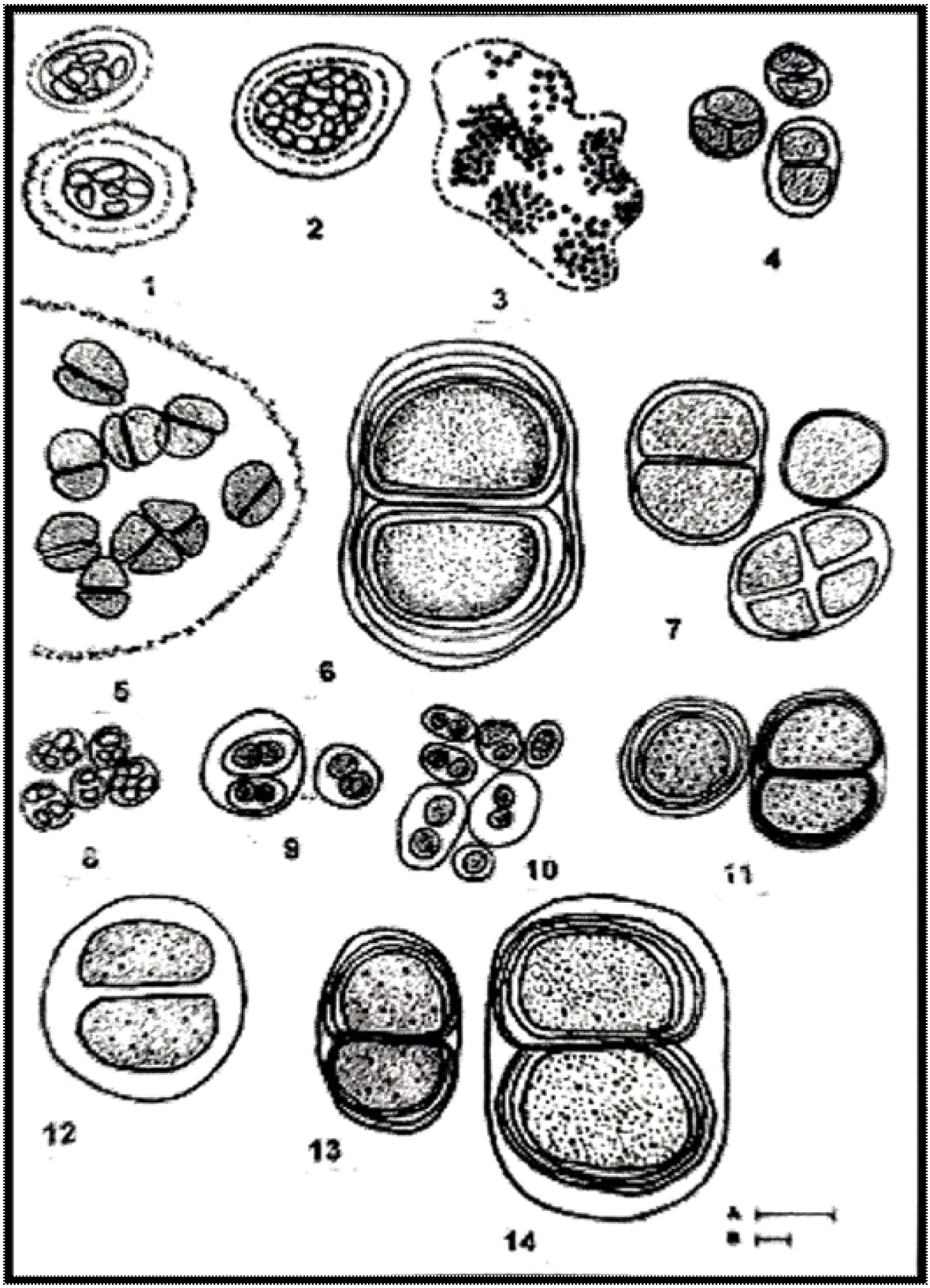


Plate 1. Mucilage on different surfaces: a) Cultivated soils, b) Moist soil, c) Near marshy places, d) On hilly slopes, e) Garden soil, f) Moist brick surface



Scale bars 10 µ

Fig 1. ***Microcystis elabens*****, Fig 2.** ***M marginate*****, Fig 3.** ***M stagnalis*****, Fig 4.** ***Chroococcus indicus*****, Fig 5.** ***C limneticus*****, Fig 6.** ***C macrococcus*****, Fig 7.** ***C minutus*****, 8.** ***C minor*****, Fig 9.** ***C montanus*****, Fig 10.** ***C pallidus*****, Fig 11.** ***C schizodermaticus*****, Fig 12.** ***C spelaeus*****, Fig 13.** ***C tenax*****, Fig 14.** ***C turgidus***

OBSERVATIONS

Systematic account
Order: Chroococcales
Family: Chroococcaceae

A. Genus: *Microcystis* Kuetz

1. *Microcystis elabens* (Bre'b) Kuetz (Fig 1): Colony spherical, flat and expanding, blue green or olive green; cells oblong, 3-4.5 µ broad, 3-6 µ long with gas vacuoles

Habitat: On soils of marshy places in rainy season, moist wet soils of Nandurbar, Dhule, Maharashtra

2. *M marginata* (Menegh) Kuetz (Fig 2): Colony round or spherical; margins of colonial mucilage single; colony ellipsoidal to ovoid in outline; cells closely arranged with gas vacuoles; cells 3 µ in diameter; small colony 22.5 µ in diameter, large colony 51 µ × 52 .5 µ in diameter; sheath 3.75 µ broad, very distinct and stratified

Habitat: Marshy places of Dhule and Jalgaon, Maharashtra

3. *M stagnalis* Lemm (Fig 3): Colonies irregular, moderately long; expanding colonial mucilage indistinct; cells spherical and pale green in colour, 1.5 µ in diameter, loosely arranged in matured colonies

Habitat: Marshy soils of Dhule, Maharashtra

B. Genus: *Chroococcus* Naeg

1. *Chroococcus indicus* Zeller (Fig 4): Thallus gelatinous; cells single or sometimes 2 in a single sheath when freshly divided, oblong to spherical, greenish, 3.75-6 µ in diameter, with sheath 9-10.5 µ in diameter; sheath 1.5 µ thick, hyaline and conspicuous

Habitat: In rainy season on moist soils of Nandurbar, Maharashtra

2. *C limneticus* Lemm (Fig 5): Cells spherical or sub-spherical after division; sheath diffluent, unlamellated, colourless; colonial mucilage broad; cell division in two or three directions; cell content blue green or yellowish; cells 4.5-10 µ in diameter

Habitat: In rainy season on moist grounds of Nandurbar and low lying areas of Dhule, Maharashtra

3. *C macrococcus* (Kuetz) Rabenh (Fig 6): Thallus mucilaginous, somewhat broad and yellowish brown; cells spherical, 2-4 together, 15-30 µ in diameter, with sheath 30-45 µ in diameter; sheath thick, colourless and lamellated

Habitat: Soils of Dhule and hilly soils of Nandurbar, Maharashtra

4. *C minutus* (Kuetz) Naeg (Fig 7): Cells spherical or oblong, single or in groups of 2-4; light blue-green; two-celled colony with sheath 15-16.5 µ × 22.5 µ in diameter, single cell with sheath 15 µ × 13.5-15 µ in diameter, without sheath 10.5 µ × 15 µ in diameter

Habitat: Hilly soils of Dhule and Nandurbar, Maharashtra

5. *C minor* (Kuetz) Naeg (Fig 8): Thallus slimy-gelatinous and dirty olive green; cells spherical, 2.25-3 µ in diameter; 4-8 celled colony with sheath 7.5 µ in diameter; sheath colourless and thin

Habitat: In rainy season very common on bricks, moist soils of most places of Nandurbar and Dhule, Maharashtra

6. *C montanus* Hansgirg (Fig 9): Thallus slimy, gelatinous and blackish brown; cells 3-4.5 µ × 4.5-6 µ in diameter, two-celled with sheath 7.5-12 µ × 15-19.5 µ in diameter

Habitat: Moist soils and common on bricks of old walls and garden soils of Dhule, Maharashtra

7. *C pallidus* Naeg (Fig 10): Thallus gelatinous, yellowish to colourless; cells single colour in elliptic oblong colonies, without sheath 3-4.5 µ in diameter, with sheath 7.5-9 µ × 9-10.5 µ in diameter, blue green; sheath colourless, unlamellated; in another sample, cells with sheath, little smaller 5.25-6 µ × 6-7.5 µ in diameter; sheath thick; considerable variations in cell size, number and colony dimensions observed in material collected from different places

Habitat: On moist walls, bricks, moist soils, near marshes, gardens, earthen pot surfaces etc of Dhule, Nandurbar and Jalgaon, Maharashtra

8. *C schizodermaticus* West (Fig 11): Cells in groups of 2-4, blue green, without sheath 7.5-13.5 µ in diameter, with sheath 15-24 µ in diameter; sheath yellow to brown, very distinct, lamellated, up to 3 µ thick

Habitat: On soils near marshy places, paddy fields of Dhule and Khandbara, Maharashtra

9. *C spelaeus* Erceg (Fig 12): Plant mass amorphous, gelatinous and hyaline; cells spherical and light yellow brown; sheath broad, hyaline and unstratified; cells 10.5-15 µ in diameter; two-celled colony with sheath 27-28.5 µ broad and 33 µ long; sheath 6 µ in thickness

Habitat: Paddy field soils of Dhule and Nandurbar, Maharashtra

10. *C tenax* (Kirchn) Hieron (Fig 13): Cells mostly in groups of 2-4, blue green or olive green, without sheath 10.5-16 µ in diameter, with sheath 19.5-24.75 µ in diameter; sheath colourless when young, yellow-brown at maturity, very thick lamellated

Habitat: Very common in rainy season in Nandurbar, Maharashtra

11. *C turgidus* (Kuetz) Naeg var *maximus* Nygaard (Fig 14): Cells in groups of 2-4, blue-green; sheath colourless lamellated; cells without sheath 15-30 µ in diameter, with sheath 37.5-52.5 µ in diameter

Habitat: Cultivated crop field soils of Dhule and Jalgaon, Maharashtra

DISCUSSION

A very little work is available on algae growing on soil. Like other microorganisms, microscopic algae become important component of soil ecosystem. These are photosynthetic organisms which add organic content in soil for healthy soil environment. Cyanophyceae members belong to prokaryotic algae and produce mucilage as their characteristic feature. Mucilage coating offers a sort of protection from direct exposure and helps them to thrive in various environments.

Present study comprises study on two mucilage forming genera *Chroococcus* and *Microcystis* of Cyanophyceae. The taxa were found to form dark brown and deep blue green or olive green coloured patches and cells were embedded in uniform or warty layer of mucilage. Genus *Chroococcus* is unicellular taxa but appears in aggregation on soils because after cell division, daughter cells are not separated from one another and get embedded in common mucilage sheath which results in formation of thick mucilage patches.

Genus *Microcystis* is colonial taxa with loosely arranged scattered cells in colony and form thin but wide mucilage patches on soil. Grass covered soil area holds and retains moisture, so soil algae survive there for considerable time as compared to exposed lands in rainy season. Generally, moist soils, wet brick surface, marshy habitats, cultivated and garden moist soils support mucilage forming algae. Present study gives a systematic account of non-filamentous 14 colonial Cyanophycean taxa. Genus *Microcystis* is represented by 3 species and *Chroococcus* by 11 species from some habitats of northern Maharashtra region.

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