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RESEARCH ARTICLE

ISOLATION AND MORPHOLOGICAL CHARACTERIZATION OF CYANOBACTERIA FROM FRESHWATER OF DHARASHIV DISTRICT, MAHARASHTRA, INDIA

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ABSTRACT

Cyanobacteria is a significant and varied group of diverse gram-negative bacteria. These prokaryotic autotrophs are important to the environment because they fix nitrogen from the atmosphere and enrich soil with organic matter. The current study describes the morphological characteristics and diversity of cyanobacteria found in the freshwater habitat of Maharashtra's Dharashiv District. During the monsoon and post-monsoon seasons of 2024, samples were taken from a variety of locations, including paddy fields, the Terna River site, and the Bori River site. Ten genera were used to identify and record a total of twenty-one species. The dominant taxa were identified as *Gloeocapsa, Oscillatoria, Anabaena,* and *Nostoc*. Cyanobacteria in Dharashiv District are remarkably diverse, according to the study, which will help with their exploitation for biotechnological, pharmaceutical, and other applications.

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INTRODUCTION

The Dharashiv district is located between latitudes 17.35 and 18.40 degrees north and 75.16 and 76.40 degrees east on the southern side of the Marathwada region. Although studies on cyanobacterial diversity have been conducted in several districts of Maharashtra, little is known about the cyanobacterial taxa of Dharashiv District, which is in a semi-arid region with seasonal water bodies and extensive paddy cultivation (Nikam *et al*., 2013; Wagh & Jadhav, 2019). Blue-green algae, or cyanobacteria, are a highly diverse group of pioneer oxygenic phototrophic prokaryotes that share traits with both bacteria and algae. These prokaryotic, oxygenic photoautotrophs have a diverse range of morphologies, ranging from unicellular coccoid forms to complex, branched filamentous taxa (Whitton & Potts, 2012). They are found to be useful in increasing soil fertility due to their ability to fix dinitrogen, soil stabilisation, and carbon sequestration in the ecosystem (Singh *et al*. 2016). They are an essential part of agroecosystems because of their capacity to live in a variety of habitats such as freshwater bodies, moist soils, paddy fields, and even arid crusts. Cyanobacteria function as natural biofertilizers in agricultural ecosystems, improving soil fertility and encouraging sustainable crop production (Roger and Kulasooriya 1980). Now a days, cyanobacteria have proved to be organisms with a potential source of various biotechnological applications such as food, feed, fuel, fertilizer, medicines, and industry. Present study focuses on the isolation, cultivation and morphological characterization of cyanobacteria in Dharashiv district to establish a baseline data for future ecological, agricultural, and biotechnological research.

MATERIALS AND METHODS

Research Area: In Maharashtra, India, the Dharashiv District is located between latitudes 17°45′ and 18°40′ N and longitudes 75°00′ and 76°15′ E. It receives about 750 mm of rain on average each year. Rainfall during the monsoon season lasts from June to September. Among the sampling locations were: Terna River, Dharashiv; Bori River, Tuljapur

***Gathering of Samples*:** Water samples were taken from the Terna and Bori rivers in the Dharashiv district during the monsoon and post-monsoon seasons (July–November 2024). Fresh algal mats, water samples, and moist soil crusts were collected in sterile plastic containers.

Surface soil samples that were 0–5 cm deep were scraped using sterile spatulas. The date, GPS location, and type of habitat were all marked on each sample.

Cultivation and Isolation: Heterocystous taxa were isolated using BG-11 medium (pH 7.5), which was nitrogen-free. Sterile Petri dishes and culture tubes with both solid and liquid media were used to inoculate the samples. The mass culture of each colony was carried out by taking a loopful of distinct colonies from agar plates and transferring it to the conical flasks. This process was repeated until axenic cultures were obtained. The incubation was conducted at 25±2°C, with a light-dark cycle of 12:12 hours and light intensity ranging from 1000 to 1500 lux.

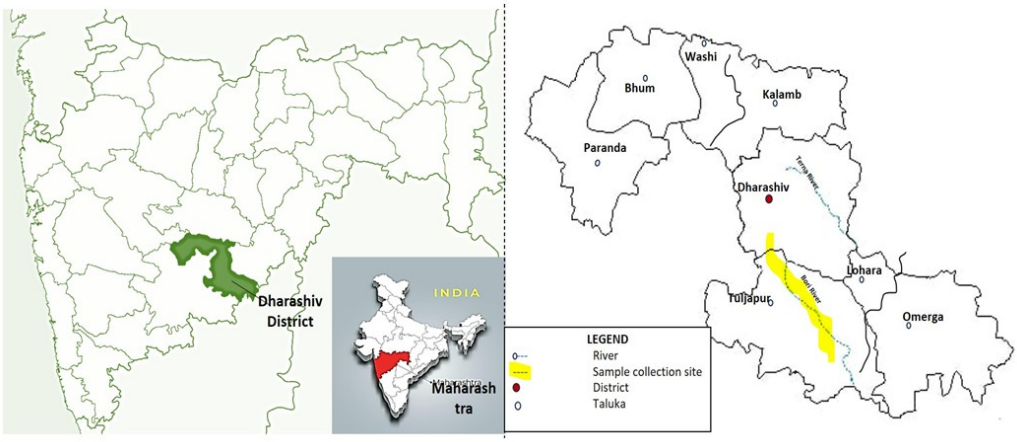


Figure 1: A map showing the Dharashiv District's sampling locations

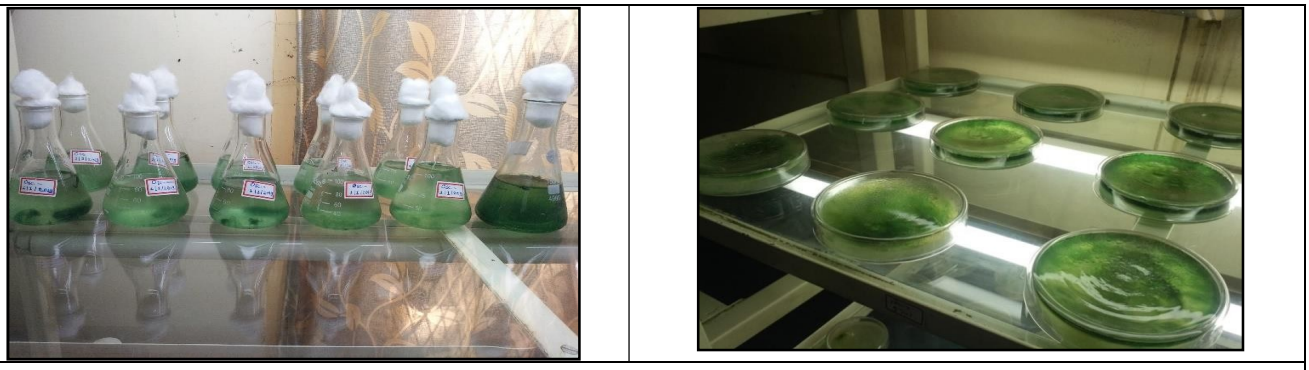


Figure 2. Enrichment and isolation of cyanobacterial culture

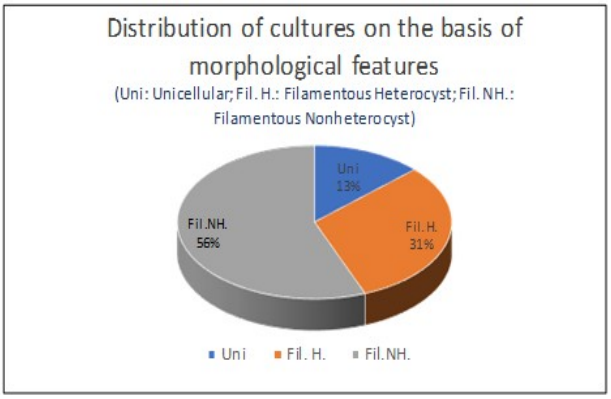


Figure 4. Relative abundance of dominant cyanobacterial genera in Dharashiv habitats

***Identification by Morphology*:** The microscopic analysis was conducted using a compound light microscope that was set to 400–1000× magnification. Branching, sheath characteristics, heterocyst and akinete morphology, cell size and shape, and trichome arrangement were among the morphological features observed. Using the books by Anand (1990) and Desikachary (1959), a large number of cyanobacteria species found in the freshwater of the Dharashiv district were identified and verified.

RESULTS

Diversity of Cyanobacteria: A total of 21 species under 10 genera were identified (Table 1 & 2).

Dominant Genera

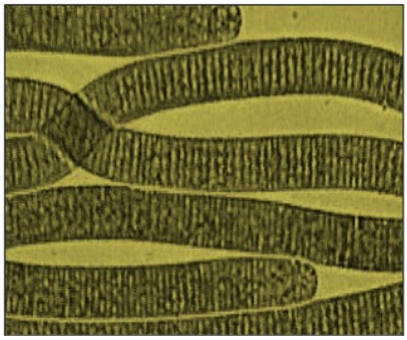
- Heterocystous: *Nostoc*, *Anabaena*
- Non-heterocystous filamentous: *Microcystis, Oscillatoria, Phormidium, Lyngbya, Trichodesmium*
- Unicellular/coccoid: *Gloeocapsa*, *Chroococcus*

Table 1. Morphological characterization of cyanobacteria from Terna River Sites of Dharashiv District

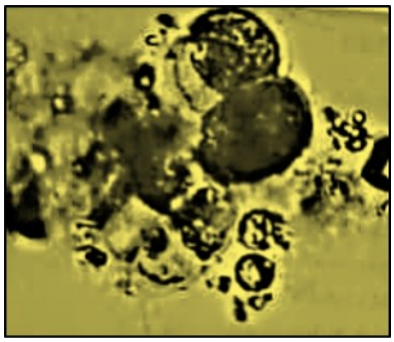
Sr. No.	WS	Species Name	Morphological Characteristics	Cell/Trichome Dimensions	Habitat
1	WS1	*Nostoc commune*	Colonies gelatinous, dark green; filaments densely entangled; heterocysts intercalary, subspherical	Spherical or subspherical, arranged like beads in chains	Paddy fields
2	*WS2*	*Nostoc muscorum*	Colonies compact; filaments enclosed in gelatinous sheath	Cells mostly spherical or oval, sometimes barrel-shaped; heterocysts large, pale yellow	Moist soils
3	*WS3*	*Anabaena doliolum*	Filamentous, heterocystous, prokaryotic, photosynthetic	Cells mostly spherical, oval, or barrel-shaped; heterocysts intercalary	Moist soils
4	*WS4*	*Oscillatoria raoi*	Filamentous, blue-green; unbranched; motile	Cylindrical or discoidal; arranged like a stack of coins	Freshwater ponds
5	*WS5*	*Oscillatoria amoena*	Filamentous, blue-green; unbranched; motile	Cylindrical or discoidal	Freshwater ponds, moist soils, slimy mats or blooms.
6	*WS6*	*Oscillatoria amphibia*	Filamentous, blue-green; unbranched; motile	Cylindrical or discoidal	Freshwater ponds, moist soils, amphibious habitat
7	*WS7*	*Oscillatoria salina*	Filamentous, blue-green; unbranched; salt-tolerant	Cylindrical or discoidal, arranged like a pile of coins	Saline water bodies
8	*WS8*	*Oscillatoria limosa*	Filamentous, blue-green; unbranched; slimy mats	Short cylindrical or discoidal cells	Moist soils, sewage, freshwater ponds
9	*WS9*	*Oscillatoria tenuis*	Filamentous, blue-green; unbranched; forms bluish-green thin mats; no heterocysts	Short cylindrical or discoidal cells arranged like a stack of coins	Freshwater ponds, streams, moist soils
10	*WS10*	*Oscillatoria formosa*	Filamentous, unbranched; bright green; mat-forming	Cylindrical cells, discoidal; arranged in long trichomes	Freshwater bodies, moist soils
11	*WS11*	*Lyngbya major*	Filamentous; trichomes enclosed in thick, firm sheath; dark blue-green	Trichomes cylindrical; sheath thick, rigid	Lake periphery

Table 2. Morphological characterization of cyanobacteria from Bori River Sites of Dharashiv District

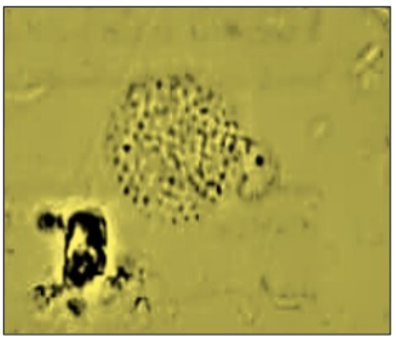
Sr. No.	WS	Species Name	Morphological Characteristics	Cell/Trichome Dimensions	Habitat
1	*WS12*	*Lyngbya corticola*	Filamentous; thick sheath; grows on tree bark (corticolous habit)	Trichomes cylindrical; sheath conspicuous	Moist bark of trees
2	*WS13*	*Lyngbya puteali*	Filamentous, robust; sheath thick and laminated	Trichomes cylindrical; cells discoidal	Freshwater wells and moist soils
3	*WS14*	*Gloeothece samoensis*	Unicellular or small colonies; cells oval to spherical; enclosed in gelatinous sheath	Individual cells oval to spherical; thick mucilaginous covering	Moist soils, freshwater habitats
4	*WS15*	*Gloeocapsa decorticans*	Colonies with distinct sheath; cells blue-green	Cells spherical, enclosed in concentric mucilaginous layers	Moist soil on canal bund
5	*WS16*	*Chroococcus minor*	Unicellular; cells spherical, in pairs or small groups; sheath colourless	Cells spherical; occur singly, in pairs, or tetrads	Paddy soil crusts
6	*WS17*	*Chroococcus minutus*	Unicellular; cells small, spherical; gelatinous sheath present	Cells minute, spherical, often in small colonies	Freshwater and moist soils
7	*WS18*	*Microcystis robusta*	Colonies irregular, embedded in gelatinous matrix; bloom-forming	Cells spherical, densely packed in mucilage	Freshwater reservoirs, eutrophic ponds, bloom-forming
8	*WS19*	*Phormidium majuscula*	Filamentous; thin sheath; trichomes motile; mat-forming	Cells cylindrical; arranged in unbranched filaments	Freshwater ponds, soil crusts
9	*WS20*	*Trichodesmium hildebrantii*	Filamentous; colonies appear as brownish-red tufts or puffs; no heterocysts	Trichomes cylindrical, free-floating, aggregated in bundles	Marine waters, especially tropical and subtropical seas
10	*WS21*	*Lyngbya commune*	Filamentous; trichomes surrounded by mucilaginous, firm sheath; mat-forming	Cylindrical trichomes; cells discoidal	Freshwater ponds, moist soils



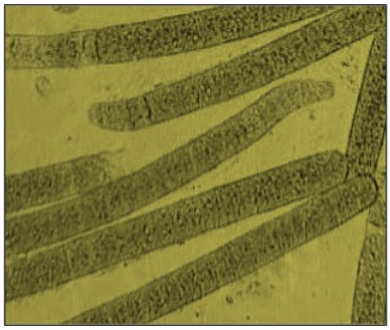
Oscillatoria sp.



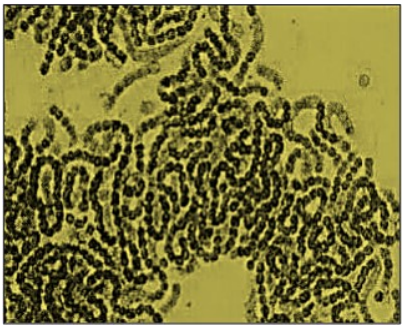
Chroococcus sp.



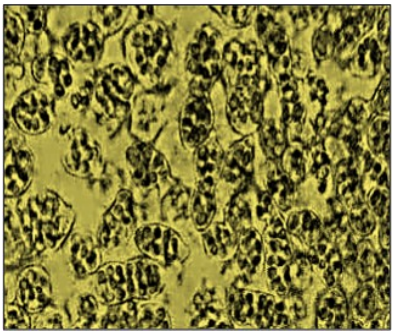
Microcystis aeruginosa



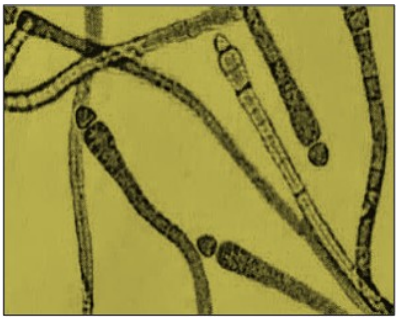
Oscillatoria sp.



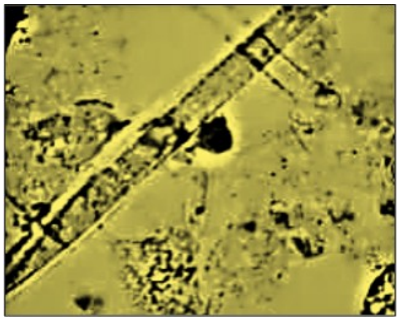
Nostoc sp.



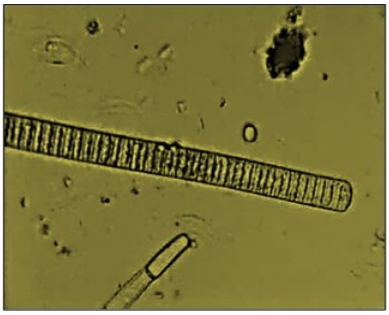
Nostoc commune



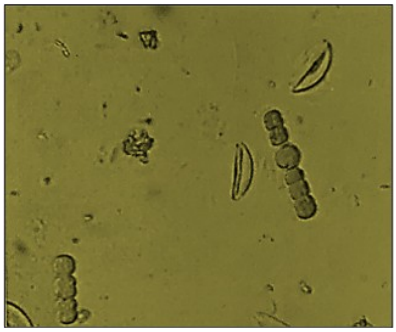
Calothrix sp.



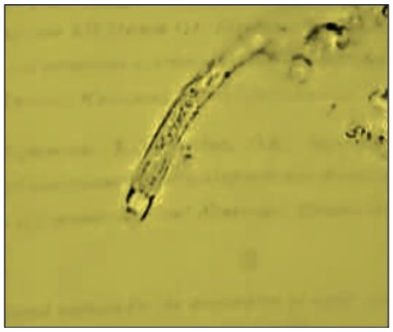
Lyngbya sp.



Oscillatoria limosa

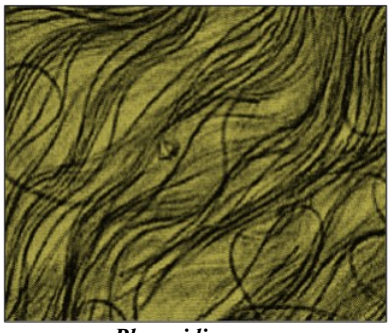


Anabaena sp.



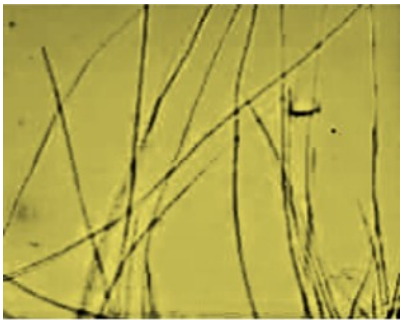
Gleotrichia echinulate

Alphanocaspsa montana



Phormidium sp.

Gloeothece sp.



Phormidium sp.

DISCUSSION

Dharashiv District's diversity is comparable other semi-arid agricultural areas in Karnataka and Maharashtra. The dominance of *Anabaena* and *Nostoc* is consistent with their established functions in improving soil fertility and fixing nitrogen. In line with earlier discoveries from comparable habitats, non-heterocystous *Oscillatoria* flourished in nutrient-rich stagnant waters (Rai *et al*., 2000). Persistence during the district's dry season is made possible by adaptations like mucilaginous sheaths (*Gloeocapsa*) and akinete formation (*Anabaena, Nostoc*). These characteristics demonstrate their potential for agriculture and ecological resilience.

CONCLUSION

This first comprehensive survey of cyanobacterial diversity in Dharashiv District reveals a rich collection of morphotypes across diverse habitats is revealed. The results lend credence to the possibility of using native strains as biofertilizers, especially in paddy farming. Future work should integrate molecular taxonomy, biomass productivity trials, and stress tolerance assessments.

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Glossary Of Abbreviations

BG : Blue Green
Fil. : Filamentous
H. : Heterocyst
NH. : Non heterocyst
Sp. : Species
Uni. : Unicellular
WS : Water Sample

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