IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Isolation and identification of soil algae from cultivated soils of Buldhana district

Authors

Gajanan Narayan Borade[1], Sunita Vishwanath Jawale[2]

Affiliation

1- Maulana Azad College of Arts, Commerce and Science, Chh.Sambhajinagar 431001(M.S.)

2- - Department of Botany, Yashwantrao Chavan College of Arts, Commerce and Science, Sillod, District Chh.Sambhajinagar 431001, Maharshtra, India

Abstract

Soil algae represent an important component of terrestrial microbial communities and play a significant role in soil fertility, nutrient cycling, and ecosystem functioning. The present study investigated the diversity and distribution of soil algae in cultivated agricultural soils of Buldhana district, Maharashtra, India. Soil samples were collected from four major agricultural tehsils representing different cropping systems, including sugarcane (*Saccharum officinarum*), soybean (*Glycine max*), chilli (*Capsicum annuum*), and pigeon pea (*Cajanus cajan*). Algal isolation was carried out using serial dilution and enrichment techniques on selective culture media such as BG-11, Bold's Basal Medium (BBM), Chu No. 10, COMBO, and WC media. The isolates were identified based on morphological characteristics using standard phycological taxonomic keys. The analysis revealed a diverse algal flora belonging to five major classes: Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae, and Xanthophyceae. Among these groups, Cyanophyceae represented the most dominant group, followed by Chlorophyceae and Bacillariophyceae, while Euglenophyceae and Xanthophyceae were comparatively less abundant. The occurrence of diverse algal taxa in cultivated soils may be associated with favourable environmental conditions created by agricultural practices such as irrigation, fertilizer application, and organic matter accumulation. Several cyanobacterial genera identified in the study, including *Anabaena*, *Nostoc*, and *Cylindrospermum*, are known to contribute to soil fertility through biological nitrogen fixation.

Keywords: Soil algae, Cyanophyceae, Chlorophyceae, Bacillariophyceae, Algal diversity, Cultivated soil, Buldhana district.

1. Introduction

Soil microorganisms constitute an essential component of terrestrial ecosystems and play a fundamental role in maintaining soil fertility, nutrient cycling, and ecosystem stability (Srivastava *et al.*, 2023). Among these microorganisms, soil algae represent an important but often overlooked group of phototrophic organisms that contribute significantly to soil biological processes (Jassey *et al.*, 2022). Soil algae include diverse taxa belonging to major groups such as Cyanophyceae, Chlorophyceae, Bacillariophyceae, Euglenophyceae, and Xanthophyceae. These organisms are capable of photosynthesis and therefore contribute to primary production, carbon fixation, and organic matter formation in soil ecosystems. In addition, soil algae interact with other microorganisms and plants, influencing soil structure, nutrient availability, and overall soil productivity (Abinandan *et al.*, 2019).

Microalgae and cyanobacteria are widely distributed in terrestrial environments and are particularly abundant in agricultural soils where moisture, nutrients, and sunlight are available (Ramakrishnan *et al.*, 2023). These organisms perform several ecological functions including atmospheric nitrogen fixation, nutrient mineralization, and stabilization of soil aggregates. Cyanobacteria, for example, are capable of fixing atmospheric nitrogen and producing extracellular polysaccharides that bind soil particles together, thereby improving soil structure and preventing erosion (Mager & Thomas, 2011). Such biological activities contribute significantly to soil fertility and the sustainability of agricultural ecosystems.

The diversity and distribution of soil algae are strongly influenced by environmental factors such as soil moisture, nutrient availability, organic matter content, and agricultural management practices (Alghanmi & Jawad, 2019). Cultivated agricultural soils often provide favourable habitats for algal growth due to regular irrigation, fertilizer application, and accumulation of crop residues, which enhance nutrient availability and microbial activity (Ramakrishnan *et al.*, 2023). Consequently, agricultural fields frequently harbour diverse algal communities that may contribute to nutrient cycling and soil productivity. Furthermore, several soil algae and cyanobacteria functions as natural biofertilizers or plant growth–promoting microorganisms due to their ability to produce phytohormones, amino acids, and other bioactive compounds that stimulate plant growth (Gonçalves, 2021).

Despite the ecological and agricultural importance of soil algae, information on its diversity and distribution in cultivated soils remains limited in many regions of India (Shukla *et al.*, 2025). In particular, systematic studies on soil algal communities in agricultural ecosystems of Maharashtra are relatively scarce. Understanding the diversity and ecological distribution of soil algae in agricultural fields is essential for evaluating its potential role in soil fertility management and sustainable agriculture.

The present study was undertaken to investigate the diversity and distribution of soil algae in cultivated agricultural soils of Buldhana district, Maharashtra. Soil samples were collected from agricultural fields representing major cropping systems of the region, including sugarcane (*Saccharum officinarum*), soybean (*Glycine max*), chilli (*Capsicum annuum*), and pigeon pea (*Cajanus cajan*). The isolated algal taxa were identified using morphological characteristics and standard phycological keys, and their distribution across different cultivated soils was analysed to understand the algal flora associated with agricultural ecosystems of the region.

2. Materials and methods

The present study was done from different locations of Buldhana district, Maharashtra for the isolation of soil algae. For this study, sampling was focused on four major cultivated talukas (tehsils) within the district; Buldhana- *Saccharum officinarum* (Sugarcane), Chikhli- *Glycine max* (Soybean), Khamgaon- *Capsicum annuum* (Chilli) and Mehkar- *Cajanus cajan* (Pigeon pea).

These tehsils were selected as representative agricultural regions with diverse soil conditions and cropping systems. Cultivated fields in these areas receive both monsoon and supplemental irrigation, which influences soil algal communities. The soil from top 10 cm was used for algal isolation.

The isolation and cultivation of soil algae were performed using standard microbiological methods, including serial dilution, agar plating, and selective enrichment on different culture media. Soil samples (approximately 10 g), previously sieved to remove debris, were suspended in 100 mL of sterile distilled water and mixed thoroughly to obtain a homogeneous stock suspension. Serial ten-fold dilutions were prepared by transferring 1 mL of the stock suspension into 9 mL of sterile distilled water to achieve dilutions from 10^{-1} to 10^{-4}. Each dilution was used for inoculation on a variety of solidified algal media to maximize recovery of different algal groups (Domingo-Quero & Alonso-Zarazaga, 2010).

For cyanobacterial isolation, BG-11 medium was used as the selective medium due to its high nitrate content and support for cyanobacterial growth (Yadav *et al.*, 2016). Approximately 1 mL of each dilution was poured or spread onto BG-11 agar plates and incubated at 28 ± 2 °C under a light intensity of ~5 Klux with an 18 h light: 8 h dark photoperiod. Heavy growth was typically observed on lower dilutions, while higher dilutions (e.g., 10^{-4}) yielded well-isolated colonies suitable for sub-culturing.

To isolate green microalgae and other freshwater taxa, serial dilutions were also inoculated onto Bold's Basal Medium (BBM) and Chu No. 10 medium, which provide balanced nutrient profiles favorable for chlorophytes and mixed freshwater algae (Lloyd *et al.*, 2021). Both BBM and Chu media were solidified with agar and incubated under the same temperature and light regime used for BG-11 to allow growth and separation of chlorophycean isolates.

In addition, mixed freshwater diatom and general algal isolation was facilitated using media such as COMBO medium and WC medium, which contained nitrate, phosphate, silicate (critical for diatom growth), trace metals, and, in the case of WC, soil extract (Gérin *et al.*, 2020). Inoculated plates were incubated to recover species belonging to Bacillariophyceae (e.g., *Navicula, Cymbella, Nitzschia*), as well as euglenoids or other mixed taxa. When isolating diatoms specifically, silicate-enriched formulations were preferred to ensure frustule synthesis.

After 10–15 days of incubation, plates showing isolated colonies or distinct algal growth were examined microscopically. Well-separated colonies or filaments were picked aseptically using sterile loops or micropipettes and transferred to fresh liquid versions of the corresponding medium for unialgal culture establishment. Pure cultures were maintained at 28 ± 2 °C under controlled illumination and deposited in the culture room for long-term preservation. These isolates were subsequently used for downstream morphological identification and functional assessments, such as evaluation of biofertilizer potential.

To determine and confirm algal growth from the enriched culture plates and liquid enrichments, all cultures were examined microscopically under compound light microscopy following standard algological protocols. Cultures were first observed for basic morphological traits such as cell shape, size, filamentous or colonial arrangement, presence of specialized cells (e.g., heterocysts in cyanobacteria, pyrenoids in chlorophytes) and characteristic frustule features in diatoms (e.g., symmetry and silica patterns) under magnifications ranging from 10x to 100x with oil immersion where necessary. Morphological features were recorded and compared against classical taxonomic descriptions to identify genera and species. For cyanobacterial taxa (blue-green algae), distinctive filament characteristics, sheath structure and cell morphometry were key criteria for differentiation. For diatoms, detailed valve morphology including shape, raphe structure and ornamentation was used to delineate species. Green algal (chlorophyte) identification relied on cell and colony arrangement, chloroplast features, and reproductive structures (Arora & Sahoo, 2015).

Identification was carried out with the help of standard, widely-accepted phycological literature, including classical keys and descriptions in Desikachary (1973) and Komárek (2012) for cyanobacteria; Anand and Kumar Hopper (1987) and Santra (1993) for freshwater algal groups; and Martinez-Goss and Arguelles (2020) for modern diagnostic criteria across multiple algal divisions.

3. Results and discussion

3.1. Diversity of Soil Algae in Cultivated Agricultural Soils

The present investigation revealed a considerable diversity of soil algae in cultivated agricultural soils of Buldhana district, Maharashtra. Soil samples were collected from four agricultural tehsils—Mehkar, Buldhana, Chikhli, and Khamgaon—representing major cropping systems including pigeon pea (*Cajanus cajan*), sugarcane (*Saccharum officinarum*), soybean (*Glycine max*), and chilli (*Capsicum annuum*). The analysis of these soils revealed a diverse algal flora belonging to five major taxonomic classes: Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae, and Xanthophyceae. Among these groups, Cyanophyceae represented the most dominant algal class, followed by Chlorophyceae and Bacillariophyceae, whereas Euglenophyceae and Xanthophyceae were comparatively less abundant.

The diversity of algal taxa recorded in the present investigation suggested that cultivated agricultural soils provided favourable environmental conditions for the growth and survival of soil algae (Joseph & Ray, 2024). Agricultural practices such as irrigation, fertilization, and crop residue accumulation created moist and nutrient-rich microhabitats that supported the proliferation of phototrophic microorganisms in agricultural ecosystems (Kabato *et al.*, 2025).

3.2. Bacillariophyceae in Cultivated Soils

Members of Bacillariophyceae (diatoms) were widely distributed across the cultivated soils of all sampling sites. Several species including *Achnanthes*, *Cocconeis*, *Cymbella*, *Fragilaria*, *Gyrosigma*, *Navicula*, *Nitzschia*, *Pinnularia*, and *Surirella* were recorded in the agricultural fields. The presence of these taxa indicated favourable moisture conditions in cultivated soils.

Diatoms were known to inhabit moist soil surfaces and aquatic habitats where thin water films were present (Johansen, 2010). Irrigation practices associated with crops such as sugarcane and chilli likely created suitable microhabitats that supported the proliferation of diatom communities in agricultural soils (Kaushik *et al.*, 2025).

3.3. Chlorophyceae in Cultivated Soils

The cultivated soils also supported a considerable diversity of green algae belonging to Chlorophyceae. Taxa such as *Chlorella vulgaris*, *Chlorella ellipsoidea*, *Chlamydomonas*, *Characium*, *Closterium*, *Coelastrum*, *Cosmarium*, *Kirchneriella*, *Oedogonium*, *Pediastrum*, *Scenedesmus bijugatus*, *Selenastrum westii*, *Spirogyra*, *Stichococcus subtilis*, and *Tetraedron minimum* were recorded in the soil samples.

Green algae were commonly associated with moist terrestrial habitats and nutrient-rich soils (Garcia-Pichel & Belnap, 2021). Agricultural soils frequently provided such conditions due to irrigation and fertilization practices. The occurrence of filamentous green algae such as *Spirogyra* and *Oedogonium* suggested the presence of adequate soil moisture levels in the cultivated fields (Pikosz & Messyasz, 2015).

3.4. Dominance of Cyanophyceae

Cyanophyceae represented the most dominant algal group observed in the cultivated soils of the study area. A large number of cyanobacterial genera were recorded, including *Anabaena*, *Aphanocapsa*, *Aphanothece*, *Chroococcus*, *Cylindrospermum*, *Gloeocapsa*, *Lyngbya*, *Merismopedia*, *Microcoleus*, *Nostoc*, *Oscillatoria*, *Phormidium*, *Plectonema*, *Spirulina*, *Synechococcus*, *Synechocystis*, and *Tolypothrix*.

Cyanobacteria were recognized as dominant components of soil algal communities because of its remarkable ecological adaptability (Bataeva & Grigoryan, 2024). Several genera identified in the present investigation, particularly *Anabaena*, *Nostoc*, and *Cylindrospermum*, were capable of biological nitrogen fixation. These organisms contributed to soil fertility by converting atmospheric nitrogen into biologically available forms.In addition to nitrogen fixation, cyanobacteria also played a role in soil stabilization through the production of extracellular polysaccharides that bound soil particles together and improved soil aggregation and stability (Mager & Thomas, 2011).

3.5. Euglenophyceae and Xanthophyceae

Members of Euglenophyceae were less abundant compared with other algal groups. Three species—*Euglena acus*, *Euglena elongata*, and *Phacus* sp.—were recorded from cultivated soils. Euglenoids typically preferred nutrient-rich environments with sufficient moisture and organic matter. Its presence in cultivated soils indicated the occurrence of temporary water films and organic nutrient availability associated with irrigated agricultural fields (Ouattara *et al.*, 2023).

Similarly, Xanthophyceae were represented by *Gloeotilopsis* sp. in cultivated soils. However, other xanthophycean taxa such as *Protosiphon botryoides* and *Vaucheria geminata* were absent in cultivated soils.

3.6. Influence of Cropping Systems on Algal Distribution

The cultivated soils examined in this study were associated with different crop cultivation systems across the district. Mehkar soils were obtained from pigeon pea fields (*Cajanus cajan*), Buldhana soils from sugarcane fields, Chikhli soils from soybean fields, and Khamgaon soils from chilli fields. Despite differences in crop type, the overall algal composition remained relatively similar across the cultivated sites. This observation suggested that environmental factors such as soil moisture, irrigation practices, and nutrient availability exerted a stronger influence on soil algal diversity than the crop species cultivated (Joseph & Ray, 2024). Crops requiring frequent irrigation, particularly sugarcane and chilli, likely created favourable conditions for algal proliferation by maintaining higher soil moisture levels. Moist soil surfaces facilitated the formation of thin water films that supported algal growth and photosynthetic activity (Häubner *et al.*, 2006).

Table 1 Isolated algae from cultivated soils of Buldhana district

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Bacillariophyceae	*Achnanthes sp.*	+	+	+	+	COMBO medium
Bacillariophyceae	*Amphora sp.*	-	-	-	-	-
Bacillariophyceae	*Cocconeis placentula*	+	+	+	+	COMBO medium
Bacillariophyceae	*Cymbella aspera*	+	+	+	+	COMBO medium
Bacillariophyceae	*Cymbella hungarica*	+	+	+	+	COMBO medium
Bacillariophyceae	*Cymbella tumidula*	+	+	+	+	COMBO medium
Bacillariophyceae	*Fragilaria construens*	+	+	+	+	COMBO medium
Bacillariophyceae	*Gyrosigma spencerii*	+	+	+	+	COMBO medium
Bacillariophyceae	*Navicula cuspidata*	+	+	+	+	COMBO medium
Bacillariophyceae	*Navicula hustedtii*	+	+	+	+	COMBO medium
Bacillariophyceae	*Navicula sp.*	+	+	+	+	COMBO medium
Bacillariophyceae	*Nitzschia obtusa*	+	+	+	+	COMBO medium
Bacillariophyceae	*Nitzschia palea*	+	+	+	+	COMBO medium
Bacillariophyceae	*Nitzschia subtilis*	+	+	+	+	COMBO medium
Bacillariophyceae	*Nitzschia yasnalii*	+	+	+	+	COMBO medium
Bacillariophyceae	*Pinnularia interrupta*	+	+	+	+	COMBO medium
Bacillariophyceae	*Pinnularia simplex*	+	+	+	+	COMBO medium
Bacillariophyceae	*Pinnularia sp.*	+	+	+	+	COMBO medium
Bacillariophyceae	*Surirella sp.*	+	+	+	+	COMBO medium
Bacillariophyceae	*Synedra sp.*	-	-	-	-	-
Chlorophyceae	*Characium debaryanum*	+	+	+	+	BBM medium

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Chlorophyceae	*Chlamydomonas sp.*	+	+	+	+	TAP medium
Chlorophyceae	*Chlorella ellipsoidea*	+	+	+	+	BBM medium
Chlorophyceae	*Chlorella vulgaris*	+	+	+	+	BBM medium
Chlorophyceae	*Chlorochoccum humicola*	-	-	-	-	-
Chlorophyceae	*Closterium sp.*	+	+	+	+	Waris's medium
Chlorophyceae	*Coelastrum microporum*	+	+	+	+	BBM medium
Chlorophyceae	*Cosmarium sp.*	+	+	+	+	Waris's medium
Chlorophyceae	*Gloeocystis gigas*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Gloeocystis major*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Kirchneriella sp.*	+	+	+	+	BBM medium
Chlorophyceae	*Oedogonium cardiacum*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Oedogonium sp.*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Pediastrum sp.*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Scenedesmus bijugatus*	+	+	+	+	BBM medium
Chlorophyceae	*Selenastrum westii*	+	+	+	+	BBM medium
Chlorophyceae	*Spirogyra sp.*	+	+	+	+	Chu-10 medium
Chlorophyceae	*Stichococcus subtilis*	+	+	+	+	BBM medium
Chlorophyceae	*Tetraedron minimum*	+	+	+	+	BBM medium
Chlorophyceae	*Trebouxia humicola*	-	-	-	-	-
Cyanophyceae	*Anabaena sp.*	+	+	+	+	BG-11 medium
Cyanophyceae	*Aphanocapsa pulchra*	+	+	+	+	BG-11 medium
Cyanophyceae	*Aphanothece nidulans*	+	+	+	+	BG-11 medium

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Cyanophyceae	*Aphanothece saxicola*	+	+	+	+	BG-11 medium
Cyanophyceae	*Arthrospira platensis*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Arthrospira platensis f. granulata*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Calothrix marchica*	-	-	-	-	-
Cyanophyceae	*Calothrix vigueri*	-	-	-	-	-
Cyanophyceae	*Campylonemopsis sp.*	+	+	+	+	BG-11 medium
Cyanophyceae	*Chlorogloea fritschii*	+	+	+	+	BG-11 medium
Cyanophyceae	*Chlorogloea microcystoides*	+	+	+	+	BG-11 medium
Cyanophyceae	*Chroococcus minor*	+	+	+	+	BG-11 medium
Cyanophyceae	*Chroococcus minutus*	+	+	+	+	BG-11 medium
Cyanophyceae	*Chroococcus turgidus*	+	+	+	+	BG-11 medium
Cyanophyceae	*Cylindrospermum alatosporum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Cylindrospermum sp.*	+	+	+	+	BG-11 medium
Cyanophyceae	*Gloeocapsa aeruginosa*	+	+	+	+	BG-11 medium
Cyanophyceae	*Gloeocapsa rupestris*	+	+	+	+	BG-11 medium
Cyanophyceae	*Gloeothece palea*	+	+	+	+	BG-11 medium
Cyanophyceae	*Hapalosiphon welwitschii*	-	-	-	-	-
Cyanophyceae	*Lyngbya aestuarii*	-	-	-	-	-
Cyanophyceae	*Lyngbya balcan*	+	+	+	+	BG-11 medium
Cyanophyceae	*Lyngbya cryptovaginata*	+	+	+	+	BG-11 medium
Cyanophyceae	*Lyngbya hieronymusii*	+	+	+	+	BG-11 medium
Cyanophyceae	*Lyngbya laxespralis*	+	+	+	+	BG-11 medium

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Cyanophyceae	*Lyngbya magnifica*	+	+	+	+	BG-11 medium
Cyanophyceae	*Lyngbya major*	+	+	+	+	BG-11 medium
Cyanophyceae	*Lyngbya majuscula*	-	-	-	-	-
Cyanophyceae	*Merismopedia punctata*	+	+	+	+	BG-11 medium
Cyanophyceae	*Merismopedia tenuissima*	+	+	+	+	BG-11 medium
Cyanophyceae	*Microcoleus acutissimus*	-	-	-	-	-
Cyanophyceae	*Microcoleus lacustris*	+	+	+	+	BG-11 medium
Cyanophyceae	*Microcoleus sociatus*	-	-	-	-	-
Cyanophyceae	*Microcoleus subtorulosus*	+	+	+	+	BG-11 medium
Cyanophyceae	*Microcystis aeruginosa*	+	+	+	+	BG-11 medium
Cyanophyceae	*Myxosarcina burmensis*	+	+	+	+	BG-11 medium
Cyanophyceae	*Nostoc commune*	-	-	-	-	-
Cyanophyceae	*Nostoc linckia*	+	+	+	+	BG-11 medium
Cyanophyceae	*Nostoc microscopicum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Nostoc muscorum*	-	-	-	-	-
Cyanophyceae	*Nostoc piscinale*	+	+	+	+	BG-11 medium
Cyanophyceae	*Nostoc punctiforme*	-	-	-	-	-
Cyanophyceae	*Oscillatoria acuminata*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria acuta*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria agina*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria animalis*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria chlorina*	+	+	+	+	BG-11 medium

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Cyanophyceae	*Oscillatoria obscura*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria princeps*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria quadripunctulata*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria schultzii*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria sp.*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria subbrevis*	+	+	+	+	BG-11 medium
Cyanophyceae	*Oscillatoria subuliformis*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium abronema*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium africanum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium ambiguum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium anomalum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium bohneri*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium jadinianum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium jenkelianum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium molle*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium pachydermaticum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium subincrustatum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium truncicola*	+	+	+	+	BG-11 medium
Cyanophyceae	*Phormidium usterii*	+	+	+	+	BG-11 medium
Cyanophyceae	*Plectonema gracillimum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Plectonema hansgirgii*	+	+	+	+	BG-11 medium
Cyanophyceae	*Plectonema nostocorum*	+	+	+	+	BG-11 medium

Class	Name of Algae	Cultivated soil				Isolation medium
		Mehekar	Buldhana	Chikhli	Khamgaon	
Cyanophyceae	*Plectonema puteale*	+	+	+	+	BG-11 medium
Cyanophyceae	*Plectonema radiosum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Scytonema bohneri*	-	-	-	-	-
Cyanophyceae	*Scytonema schmidtii*	-	-	-	-	-
Cyanophyceae	*Spirulina gigantea*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Spirulina laxissima*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Spirulina major*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Spirulina subtilissima*	+	+	+	+	Zarrouk's medium
Cyanophyceae	*Stigonema hormoides*	-	-	-	-	-
Cyanophyceae	*Synechococcus aerugineus*	+	+	+	+	BG-11 medium
Cyanophyceae	*Synechococcus cedrorum*	+	+	+	+	BG-11 medium
Cyanophyceae	*Synechocystis aquatilis*	+	+	+	+	BG-11 medium
Cyanophyceae	*Tolypothrix sp.*	+	+	+	+	BG-11 medium
Cyanophyceae	*Xenococcus kerneri*	+	+	+	+	BG-11 medium
Euglenophyceae	*Euglena acus*	+	+	+	+	EG medium
Euglenophyceae	*Euglena elongata*	+	+	+	+	EG medium
Euglenophyceae	*Phacus sp.*	+	+	+	+	EG medium
Xanthophyceae	*Gloeotilopsis sp.*	+	+	+	+	WC medium
Xanthophyceae	*Protosiphon botryoides*	-	-	-	-	-
Xanthophyceae	*Vaucheria geminata*	-	-	-	-	-

+: Occurred, -: not occurred

4. Conclusion

The present investigation revealed a rich diversity of soil algae in cultivated agricultural soils of Buldhana district, Maharashtra. Five major algal classes—Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae, and Xanthophyceae—were recorded from soils associated with major cropping systems including sugarcane, soybean, chilli, and pigeon pea. Among these groups, Cyanophyceae emerged as the dominant algal class, followed by Chlorophyceae and Bacillariophyceae, whereas Euglenophyceae and Xanthophyceae were comparatively less abundant.

The results indicated that agricultural practices such as irrigation, fertilization, and the accumulation of organic residues created favourable environmental conditions that supported diverse soil algal communities. Cyanobacterial genera identified in the present study were recognized for their ecological importance, particularly their ability to fix atmospheric nitrogen and enrich soil nutrient pools. Such nitrogen-fixing cyanobacteria contribute significantly to soil fertility, nutrient cycling, and the stability of agricultural ecosystems. Furthermore, soil algae are known to enhance soil biological activity, improve soil structure through the production of extracellular polysaccharides, and contribute to carbon sequestration and nutrient transformation processes in soils.

Acknowledgement

Authors would like to acknowledge Maulana Azad College of Arts, Commerce and Science, Chh.Sambhajinagar 431001(M.S.) to provide the necessary infrastructure to carry out the work.

References

Abinandan, S., Subashchandrabose, S. R., Venkateswarlu, K., & Megharaj, M. (2019). Soil microalgae and cyanobacteria: the biotechnological potential in the maintenance of soil fertility and health. *Critical reviews in biotechnology*, *39*(8), 981-998.

Alghanmi, H. A., & Jawad, H. M. (2019). Effect of environmental factors on cyanobacteria richness in some agricultural soils. *Geomicrobiology Journal*, *36*(1), 75-84.

Anand, N., & Kumar Hopper, R. S. (1987). Blue-green algae from rice fields in Kerala State, India. *Hydrobiologia*, *144*(3), 223-232.

Arora, M., & Sahoo, D. (2015). Growth forms and life histories in green algae. In *The algae world* (pp. 121-175). Springer.

Bataeva, Y., & Grigoryan, L. (2024). Ecological features and adaptive capabilities of cyanobacteria in desert ecosystems: A review. *Eurasian Soil Science*, *57*(3), 430-445.

Desikachary, T. (1973). Status of classical taxonomy. In *The biology of blue-green algae*. Univ. of Calif. Press Berkeley.

Domingo-Quero, T., & Alonso-Zarazaga, M. Á. (2010). Soil and litter sampling, including MSS. *Abc taxa*, *8*(1), 173-212.

Garcia-Pichel, F., & Belnap, J. (2021). Cyanobacteria and algae. *Principles and applications of soil microbiology*, 171-189.

Gérin, S., Delhez, T., Corato, A., Remacle, C., & Franck, F. (2020). A novel culture medium for freshwater diatoms promotes efficient photoautotrophic batch production of biomass, fucoxanthin, and eicosapentaenoic acid. *Journal of Applied Phycology*, *32*(3), 1581-1596.

Gonçalves, A. L. (2021). The use of microalgae and cyanobacteria in the improvement of agricultural practices: a review on their biofertilising, biostimulating and biopesticide roles. *Applied Sciences*, *11*(2), 871.

Häubner, N., Schumann, R., & Karsten, U. (2006). Aeroterrestrial microalgae growing in biofilms on facades—response to temperature and water stress. *Microbial ecology*, *51*(3), 285-293.

Jassey, V. E., Walcker, R., Kardol, P., Geisen, S., Heger, T., Lamentowicz, M., Hamard, S., & Lara, E. (2022). Contribution of soil algae to the global carbon cycle. *New Phytologist*, *234*(1), 64-76.

Johansen, J. R. (2010). Diatoms of aerial habitats. *The diatoms: applications for the environmental and earth sciences*, *2*, 264-276.

Joseph, J., & Ray, J. G. (2024). A critical review of soil algae as a crucial soil biological component of high ecological and economic significance. *Journal of phycology*, *60*(2), 229-253.

Kabato, W. S., Hailegnaw, N., Chaffamo, T. E., Samuel, A., De Silva, A., & Molnár, Z. (2025). Microalgae-Based Strategies for Soil Health and Crop Productivity: Mechanisms, Challenges, and Pathways to Climate-Resilient Agriculture. *Agronomy*, *15*(11), 2669.

Kaushik, R., Tiwari, A., & Ulmann, L. (2025). Diatoms and Their Role in the Sustainable Agricultural Circular Economy. In *Diatoms and Sustainable Agriculture* (pp. 1-19). CRC Press.

Komárek, J. (2012). Nomenclatural changes in heterocytous cyanoprokaryotes (Cyanobacteria, Cyanophytes). *Fottea*, *12*(1), 141-148.

Lloyd, C., Tan, K. H., Lim, K. L., Valu, V. G., Fun, S. M. Y., Chye, T. R., Mak, H. M., Sim, W. X., Musa, S. L., & Ng, J. J. Q. (2021). Identification of microalgae cultured in Bold's Basal medium from freshwater samples, from a high-rise city. *Scientific reports*, *11*(1), 4474.

Mager, D., & Thomas, A. (2011). Extracellular polysaccharides from cyanobacterial soil crusts: a review of their role in dryland soil processes. *Journal of Arid Environments*, *75*(2), 91-97.

Martinez-Goss, M. R., & Arguelles, E. (2020). Classical Taxonomy. *Philippine Science Letters*, *15*, 145-153.

Ouattara, M., Zongo, F., & Zongo, B. (2023). Diversity of euglenoids in a drinking water source in Burkina Faso (West Africa): implications for sustainability and water quality. *African Journal of Aquatic Science*, *48*(2), 178-188.

Pikosz, M., & Messyasz, B. (2015). Composition and seasonal changes in filamentous algae in floating mats. *Oceanological and Hydrobiological Studies*, *44*(2), 273-281.

Ramakrishnan, B., Maddela, N. R., Venkateswarlu, K., & Megharaj, M. (2023). Potential of microalgae and cyanobacteria to improve soil health and agricultural productivity: a critical view. *Environmental Science: Advances*, *2*(4), 586-611.

Santra, S. (1993). *Biology of Rice-fields blue-green algae*. Daya Books.

Shukla, S., Upadhyay, D., Mishra, A., Jindal, T., & Shukla, K. (2025). The impact on soil ecology of the algal community. In *Soil Algae: Morphology, Ecology and Biotechnological Applications* (pp. 193-219). Springer.

Srivastava, P., Sachan, K., Baskar, P., Saikanth, D., Lytand, W., Kumar, R., & Singh, B. V. (2023). Soil microbes expertly balancing nutrient demands and environmental preservation and ensuring the delicate stability of our ecosystems-a review. *International Journal of Plant & Soil Science*, *35*(18), 989-1000.

Yadav, A., Dubey, K., Parveen, S., Rout, S., & Singh, D. (2016). Influence of BG-11 culture media on growth of Cyanobacteria, Oscillatoria Species. *J. Appl. Sci*, *2*, 38-42.