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Diversity of bark algae from Chhatrapati Sambhajinagar, Maharashtra, India

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Abstract
Bark of tree is a suitable habitat for the growth of algae. It provides humus and proper substratum for algal growth. Algae growing on the barks are subaerial in habitat. They are also called as epiphloeophytes. In present research work bark algae growing on the barks of *Albizia lebbek* (L.) Benth, *Polylthia longifolia* (Sonn.) Thwaites and *Zizyphus mauritiana* Lamk. from the adjoining areas of Chhatrapati Sambhajinagar were collected, observed and identified. Collection of bark algal samples were made in the months of July, August and September 2023. A total of 24 species of algae under 15 genera belonged to Chlorophyceae and Cyanophyceae were recorded. Cyanophycean algae were found dominant. *Chlorella vulgaris*, *Trebouxia humicola*, *Aphanothece nidulans*, *Phormidium molle*, *Lyngbya major* and *Plectonema gracillimum* were found dominant. Maximum number of algal taxa were found on the bark of *Albizi leebek*. Present research work is significant in diversity study of subaerial algae of selected area.

Keywords: Bark algae, Subaerial habitat and Cyanophycean algae

Introduction

The bark is outermost layer of stem of tree which protects the plant from insects and attack of pathogens. It harbours number of microbes, insects, worms, mosses, lichens and algae. Bark provides humus and suitable substratum for algal growth. Algae growing on the bark are subaerial in habitat and called as epiphloeophytes. As these algae inhabiting bark of tree are also Known as corticolous. They receive moisture either solely from the atmosphere or fairly steady source of water seeping through moss mats. Algal propagules brought through wind and rain water flowing through the bark colonizes on bark with the help of favourable. climatic conditions. For the development of bark algae particular climatic conditions are required such as high relative humidity high and evenly distributed rainfall, low temperature and low to high photon irradiance. Algae most commonly grow on bark of trees in moist tropical climates, but several species are also able to grow on bark of trees even in temperate subtropical climate. Bark properties such as texture, fissuring, dust deposition regulate the composition of bark algal flora (Jadhav *et al*. 2023) [14]. Julia Snow (1899) [27] observed abundance of *Pleurococcus* in bark algal samples. Islam (1960) [12] observed that very heavy rainfall and prevailing humidity provides ideal conditions for growth of subaerial algae. Marion (1969) [21] conducted survey on bark algae of different trees located in Charleston - Illineis and reported widely distribution of *Protococcus*, *Nanochloris*, *Stichococcus* and *Utothrix*. Cox and Hightower (1972) [7], Wylie and Schlichting (1973) [28] and Handa and Nakeno (1998) [11] extensively worked on bark algae. Katharina *et al*. (2008) [16] studied role of bark algae in monitoring airborne pollutants such as ozone and particulate matter. Neustupu and Skaloud (2008 and 2010) [23, 24] and Neustupu and Anna (2013) [25] studied extensively diversity and distribution of bark algae from tropical region. Lemes *et al*. (2008 and 2012) [19, 20] recorded corticolous cyanobacteria and green algae from tropical forests of Brazil. Sarirm *et al*. (2011) [26] reported 40 species of bark algae from Pakistan. Alwi *et al*. (2015) [1] studied effects of bark pH on diversity and density of bark algal compositon. They observed that pH of bark help in the alteration of microalgal compostion.

In India except few reports not much work has been carried out on bark algae. Bruhl and Biswas (1923) [5] studied bark algae from Kerala. Kamat and Harankhedkar (1976) [15] and Ashtekar (1980) [3] reported bark algae from Nagpur and Aurangabad, Maharashtra. Biswas (1984) [4] studied role of aerophilous algae in producing colour effect on bark of tree. Kumar and Paliwal (2006) [18] studied distributional pattern of cyanobacteria on bark of different trees. Mikter *et al*. (2006) [22] worked on bark algal flora of some selected trees of Arunachal Pradesh. Chandra and Krishnamurthy (2006) [6] reported species of diatoms from tree trunk. Ghosh (2013) [9] reviewed work on bark algal flora. Kharkongor and Ramanujan (2014)[17] recorded 85 taxa of algae from tree barks of closed undisturbed sacred groves, mixed plantation and open disturbed forest of Meghalaya. Ambika and Krishnmurthy (2019) [2] studied diversity of algae and cyanobacteria on tree barks of tropical forests. Recently Jadhav (2022) [13] and Jadhav *et al*. (2023) [14] worked on bark algae of Daulatabad and Khultabad region of Aurangabad district in Maharashtra. They observed dominance of *Chlorella vulgaris*, *Chlorococcum humicola*, *Pinnularia* sp., *Aphanothece nidulans*, *Myxosarcina burmensis*, *Phormidium abronema*, *Phormidium molle*, *Lyngby a major*, *Microcoleus acutissimus*,. *Nostoc microscopicum*, *Nostoc muscorum* and *Tolypothrix campylonemoides*. Present research work deals with the study of bark algae from adjoining areas of Chhatrapati Sambhajinagar city of Maharashtra. During rainy season bark algae growing on barks of angiospermic plants *Albizia lebbek* (L.) Benth, *Polylthia longifolia* (Sonn.) Thwaites and *Zizyphus mauritiana* Lamk.were studied.

Material and Methods

Rainy season is the considered to be the most favourable season for the growth of bark algae. During rainy season because of consistent and high rainfall, algal growth was

occurred mainly on the barks of *Albizia lebbek, Polylinia longifolia* and *Zizyphus mauritiana*. Collection of bark algal samples were made in the months of July, August and September 2023. Bark algal samples measuring 1cm² were collected by gently scraping the bark with the help of sterilized scalpel from around the tree trunk at a height of 1.5 meter above the ground. Care was taken to ensure that there was no cross-contamination between samples by sterlizing the scalpel with alcohol after each sample collection. A total of 27 samples were collected throughout the period of study. Samples were collected separately in collection bottles and brought to the laboratory for further taxonomic into investigation. Collected algal samples were observed under research microscope and identified by referring to the standard literature on algae.

Results and Discussion

A total of 24 species under 15 genera belonged to Class Chlorophyce and Cyanophyceae were identified and recorded. Cyanophycean algae were found dominant which is followed by Chlorophyceae (Table 1 and 2). Wylie and Schlichting (1973) [28], Kamat and Harrankhedkar (1976) [15], Mikter *et al*. (2006) [22], Neustupu and Skaloud (2008) [23], Kharkongor and Ramanujan (2014) [17], Jadhav (2022) [13] and Jadhav *et al*. (2023) [14] also recorded dominance of Cyanophycean algae in bark algal flora. Our results are in conformity with the results of earlier workers. In present Study *Chlorella vulgaris, Trebouxia humicola, Aphanothece nidulans, Phormidium molle Lyngbya major* and *Plectonema gracillimum* were found dominant. Ashtekar (1980) [3] recorded abundance of *Oscillatorria, Phormidium, Lyngbya* and *Microcoleus*. Katharina *et al*. (2008) [16] reported dominance of *Apatococcous lobatus, Chlorella elliposidea, Chlorella vulgarris, Chlorella saccharophila* and *Demococcus endolithicus.*

Maximum number of algal taxa were found on the bark of *Albizia leebek* which is followed by *Polyalthia longifolia* and *zizyphus mauritiana* (Table 3). Properties of bark regulate the composition of bark algal flora. Bark algae are microhabitats developed on various tree barks. Bark surface pH Plays an important role in community structure of corticolous organisms (Neustua and Anna 2013) [25]. Cyanobacterial abundance is related to increase in bark pH. Green algae as compared to other algal groups normally grow better at a higher pH of bark. Alkaline pH of bark alters microalgal composition. (Alwi *et al*. 2015) [1]. Bark algae are highly sensitive to the pollution and temperature fluctuations. In moist tropical climate algae commonly grows on bark of trees but some species are also able to grow on trees in temperate subtropical climate. The Marathwada region of Maharashtra has a dry climate, but during rainy season, the occurrence of algae on barks is found tree bark is quite interesting and encouraging.

Table 1: Algal taxa recorded from barks of trees

Sr. No.	Algal taxa	*Albizia Lebbek* (L.) Benth.	*Polylthia longifolia* (Sonn.) Thwaites.	*Zizyphus mauritiana* Lamk.
I.	**Chlorophyceae**			
1.	*Gloeocystis* gigas (Kuetz.) Lageheim	-	-	+
2.	*Gloeocystis* major gerhekex Lemmerahh	+	-	-
3.	*Chlorococcum* humicola (Naeg.) Rabenhorst	+	-	+
4.	*Trebouxia* humicola (Treboux.) West.et. Fritscn	+	+	-
5.	*Chlorella* vulgaris Beyerinck	+	+	+
II.	**Cyanophyceae**			
1.	*Chroococcus* minor (kuetz.)Nag.	-	-	+
2.	*Gloeothece* palea (Kuetz.) Rebenn.	+	-	+
3.	*Aphanothece* nidulans Richter	+	+	+
4.	*Aphanothece* saxicola Nag.	+	+	-
5.	*Myxosarcina* burmensis Skuja	+	+	+
6.	*Oscillatoria* obscura Bruhl et. Biswas	+	-	-
7.	*Phormidium abronema* Skuja	+	+	-
8.	*Phormidium* molle (Kuetz.) Gomont	+	+	+
9.	*Lyngbya* aerugineo-coerula (Kuetz.) Gomont	-	-	+
10.	*Lyngbya* cryptovaginata Schkorbatow	-	+	-
11.	*Lyngbya* gracilis (Menegh.) Rabenh	+	-	-
12.	*Lyngbya* major Menegh ex Gomont	+	+	-
13.	*Microcoleus* acutissimus Gardner	-	+	-
14.	*Nostoc* microscopicum Carm.ex. Borh et Flah	+	-	-
15.	*Nostoc* muscorum Ag.ex. Borh et Flah	+	-	-
16.	*Nostoc* punctitformae (Kuetz.) Hariot	-	+	-
17.	*Plectonema* gracillimum (zopf.) Hansg.	+	+	-
18.	*Scytonema* bohneri Schmidle	-	-	+
19.	*Scytonema* schmidtii Gomont	-	+	-

Table 2: Classwise number of algal genera and species recorded bark of trees.

Sr. No.	Class	Genera	Species
1.	Chlorophyceae	04	05
2.	Cyanophyceae	11	19
	Total	15	24

Table 3: Treewise algal taxa observed on bark of trees.

Sr. No.	Tree	Class		Total
		Chlorophyceae	Cyanophyceae	
1.	*Albizia Lebbek* (L.) Benth.	04	12	16
2.	*Polylthia longifolia* (Sonn.) Thwaite.	02	11	13
3.	*Zizyphus mauritiana* Lamk.	03	07	10

Conclusion

21 taxa of bark algae were recorded during present study. Cyanophycean algae dominated bark algal flora. In India except few reports rare attention has been paid towards bark algae. Present research work highlights the occurrence of bark algae in Marthwada region of Maharashtra. The overall climate of Marathwada region is dry, but during rainy season algae occur on tree bark and it is an interesting ecological Phenomena. Ecological factors such as rainfall, relative humidity, temperature and photon irradiation plays an important role in diversity and abundance of algae on bark of tree. Texture of bark surface, deposition of dust on bark surface and bark pH are important features in growth of algae. Preset research work enriches the knowledge of bark algal flora of India. In future there is an urgent need to work continuously and extensively on bark algal flora to understand its ecological role.

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