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Colonization of micro-algae on the painted iron surfaces.

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Abstract
Painted metal surfaces are specialized aero-terrestrial habitats for algal growths. Though there are extensive documentation of microbial activities on painted building facades, stone surfaces and wall paintings, the occurrence on painted iron surfaces was not recorded so far. In the present work a coccal green algal species *Apatococcus lobatus* was found growing extensively on the painted iron surfaces in the AJC Bose Indian Botanic Garden, Howrah.

Key words – Indian Botanic Garden, Micro-algae, Painted iron surfaces

Introduction

Microalgae occur in wide range of aero-terrestrial habitats like stone monuments, building facades, biological soil crusts and snow surfaces, forming green, blue-green, blackish and sometimes coloured patches. The aero-terrestrial habitats are characterized by wide range of temperature and solar radiation amplitudes. Most important feature in such habitats is the water availability which is supplemented due to rain or atmospheric moisture. The persistence of water in a habitat depends on evaporation rate which in turn is coupled with atmospheric temperature, velocity and composition of air, angle intensity, quality, quantity, duration and direction of sun light. Nutrients to such habitats are transported by rainwater, aerosols and dust or soil particles. Metal and vinyl surfaces are not porous so growth of the algae on these surfaces is not easily possible. But, in due course of time due to rusting and chemical erosion of the metallic surface small rough patches are formed on the metal on which due to deposition of dust and spores and with availability of moisture, growth of algae takes place on these patches which repeatedly increases every year. The bio-films on these substrata are a consortium of not only microalgae but also other microbes like bacteria and fungi. Generally, the algal biota in such habitats is dominated by green algae in temperate climatic regions, whereas cyanobacteria dominate in warm temperate to tropical regions (Samad & Adhikary 2008). The green algae, due to their small size and large population size, produce large amounts of new propagules (cysts or spores) capable of disposal on very long distances. These are also highly tolerant against low water availability, which is partly based on the biochemical capability to synthesize and accumulate 'water-holding polyols' (Gustavs et al. 2011).

Paints used on metal surfaces are made up of several organic and inorganic constituents, many of which are biodegradable, facilitating the growth of microbes in their favorable environmental conditions (Ciferri 1999). Occurrence of cyanobacteria (blue-greenalgae) and microalgae on painted stone or cemented surfaces and the damage caused due to them was studied extensively (Wee 1988, Ortega-Cal et al. 1991, Gaylarde & Gaylarde 1999). Microbial activities on wall paintings also analyzed by several workers (Getlens et al. 1941, Ross 1963, Strezelczyk 1981, Wright 1986, Petushkova & Lyalikova 1986, Agrawal et al. 1989, Inoue & Koyano 1991, Altenburger et al. 1996, Joshi and Mukundan 1997, Ciferri 1999). But, algal colonization on painted metal surfaces and their metabolism of biodeterioration was scantily studied.

AJC Bose Indian Botanic Garden (AJCBIBG) is situated on the west bank of river Ganga (Hooghly). Thus it provides a congenial atmospheric condition for algal growth on aero-terrestrial habitats. Documentations of algae of AJCBIBG were few and confined only to the lakes (Sau & Gupta 2005; Das & Adhikary 2014) and tree barks (Biswas 1932; Gupta 2008; Gupta 2010). Algal growth on other sub-aerophytic habitats like building facades, monuments and painted metal surfaces inside the garden premises were not explored earlier. In this context, the present work was carried out studying the algal colonization on the painted iron surfaces as green patches inside the AJC Bose Indian Botanic Garden, Howrah.

Materials and methods

Study sites

Acharya Jagdish Chandra Bose Indian Botanic Garden was established in 1787, is geographically located between 22°35' N latitude and 88°21' E longitude and at the elevation of 4.6 m above the sea level, in Sibpur (Howrah), West Bengal. The garden covers an area of 273 acres on the west bank of river Ganga (Hooghly). The area experiences annual rainfall of about 1536 mm and the temperature of the locality ranges from 16°C - 31°C.

Collection and study of algal samples

Samples were collected from several painted iron surfaces, i.e iron fences, street light poles, etc. inside the Botanic garden (Figure 1 a – c) during monsoon season (July – Sptember, 2014). Algal bio-films from the surfaces were scrapped using scalpel and tooth brush. The samples were deposited in algal section of Cryptogamic unit of Botanical Survey of India, Howrah. Light microscopic observations and morphological study was made with Nikon microscope Ni – 11 fitted with Nikon Digital Camera DS – Ri1 – U3 and operated by Nikon Imaging Software NIS – D + EDF and electron microscopic study was made using FEI Quanta 200 Scanning Electron Microscope.

Figure 1. a – b. Growth of *Apatococcus lobatus* on painted iron surfaces, c. Corrosive activities of the growth of algae on eroded surface of painted iron surfaces

Results and discussion

A coccal green algal taxon *Apatococcus lobatus* (Chodat) J.B. Petersen (Order: Chlorococcales, Class: Chlorophyceae), was found growing extensively on several painted iron surfaces inside the AJC Bose Indian Botanic Garden. Their occurrence was inversely proportional to the availability of sunlight in different localities, proved their dependency on atmospheric moisture. The present algal species is a first time documentation of algae growing on iron fences with a new distributional record from India.

***Apatococcus lobatus* (Chodat) J.B. Petersen** in Bot. Iceland 2: 424. 1928. *Pleurococcus lobatus* Chodat, Alg. Vertes Suisse 284. 1902.

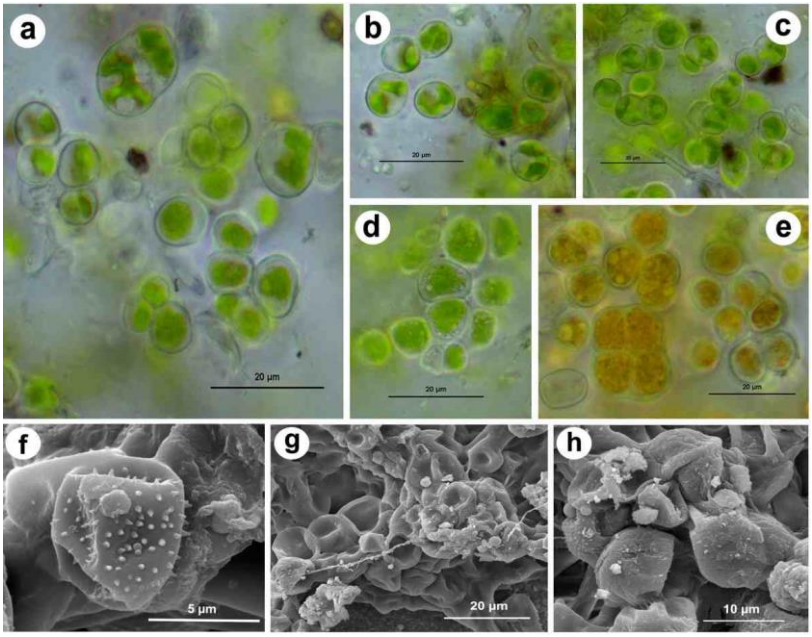

Figure 2. a – e. Cellular morphology and colony formation of *Apatococcus lobatus*, f – h. scanning electron microscopic images of *A. lobatus* and its adherence to the paint particles.

Cells spherical to slightly irregular in shape, when mature divided in both horizontal and vertical planes to give a structure of 2-4 celled packets, cells 3.7-7.2 µm in diameter, chloroplasts parietal, pyrenoid inconspicuous, mature cells with distinct oil droplets, asexual reproduction by autospores.
Habitat: Found growing on the painted iron surfaces like iron fences around the Central National Herbarium (CNH) building, street light poles near CNH building, Bicentenary gate.

This taxon was recorded as a new distributional record from India though the genus *Apatococcus* is considered to have a cosmopolitan distribution with wide range of occurrence in Australia and New Zealand (Bostock & Holland, 2010) as well as in Europe, Asia and Africa (Rindi, 2007). The intensity and direction of the light availability on these fences played a pivotal role for the growth of microalgae. Though the species is photosynthetic, its occurrence was more in the shady places in comparison to the exposed localities, which is may be due to differential availability of atmospheric moisture in both the conditions. Another environmental factor which regulates the differentiation in occurrence of the organism is the direction of the wind, as it was observed that the eastern facades of the surfaces had more colonization in comparison to the western facades. The metabolism of this microbial activity on this specialized substrate deserves more detailed study.

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