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Report on the Occurrence and Taxonomy of Dichothrix Zanardini Ex Bornet & Flahault 1886 and Fischerella (Bornet Et Flahault) Gomont 1895– Two Rarest Filamentous Cyanobacteria from West Bengal, India

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ABSTRACT

Objective: The author intended to investigate the diversity of cyanobacteria which is considered to be omnipresent and at the same time examine the role of the taxa in the ecosystem at the site of occurrence. The work was also undertaken to describe the obtained taxa, following taxonomic processes.

Methods: Random sampling was done from different locations of the district of Burdwan in West Bengal. Live samples, as well as soil from target sites, were collected and investigated following standard systematic protocols for cyanobacterial taxonomy.

Results: In this present investigation the author reported the occurrence of two very rare and filamentous types of cyanobacteria [viz. *Dichothrix* & *Fischerella*] from different locations of said area. The detailed taxonomic analysis of each tax an along with scientific drawing will not only help in systematics but also will add to the distribution pattern of the concerned group across the world.

Conclusion: The results of this investigation will add a definite and conclusive understanding on the existence of two rarest forms of filamentous cyanobacteria which were never known from this part of the world. The author also tried to investigate the role of these taxa on the ecosystem. Though present communication is mainly on the taxonomy of the obtained taxa.

Key Words: Cyanobacteria, *Dichothrix*, *Fischerella*, First-report, India, West Bengal

INTRODUCTION

To investigate the occurrence of Cyanobacteria [1], the present work was undertaken to evaluate the diversity and systematics of the concerned group. The organism belonging to the group phenotypically may be divided into two distinct forms – Coccoid & Filamentous [2]. The investigation was undertaken on the said group for several reasons. The cyanobacteria for economic reasons, taxonomic reasons and from the evolutionary point of view is very important. In the present investigation, two such taxa were taken into consideration which is very interesting from the point of view of overall plant evolution. We all know that introduction of a branching pattern is considered as one of the advancements in the evolutionary line. The obtained taxa exhibit initiation of various branching patterns in their vegetative trichome structure.

Time-to-time several workers had tried to accumulate scattered data about Cyanobacteria from diversified habitats of different parts of this continent. But apart from the very extensive monographic study by very few workers like Desikachary (1959); Prasad and Srivastava (1992) on Andaman flora, no significant studies on the diversity of the concerned group has been done on Cyanobacteria particularly from this part of India. The author thus tried to examine different locations to study the occurrence of different forms of cyanobacteria.

Both the taxa obtained during this investigation points towards advancement by manifestation of branching in the thallus. *Dichothrix* [3] as a genus is not very common in occurrence worldwide. The *Dichothrix* is known to be represented by 44 species to date [4]. The taxa of the concerned group are known to occur only as of the benthic form on

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other submerged plants or other algae, sometimes on rocks present at the bottom of the aquatic body. Many species are marine. In the present investigation, the author obtained two species, out of which one is the first report from India and another is the first report from the state.

The genus *Fischerella*[5] is also very rare in occurrence compared to other related taxa. The taxa are represented by 22 species worldwide to date[4]. The taxa are very interesting to the phycologists and microbiologists as it exhibits true branching pattern and at the same time dimorphic branching pattern. In the present investigation, the author obtained two species, out of which one is the first to report from India and another is the first report from the state.

The obtained result of this investigation will add a definite and conclusive understanding of the existence of two rarest forms of filamentous cyanobacteria which were never known from this part of the world. The author also tried to investigate the role of these taxa on the ecosystem. The systematic description of obtained taxa along with scientific drawings should be of great help in the identification of the said taxa by future workers. The author believes, evolutionary biologists and toxicologists will benefit immensely benefitted through the outcome of this investigation.

MATERIAL & METHOD

The samples were collected from different localities of the concerned district. While collecting the samples special attention was paid to the sewage canals and stagnant water bodies near rice fields and populated localities. The soil samples were also collected along with the algal samples following standard ecological techniques i.e. from 4-5 different points at the vicinity of the spots of interest, for limnological analysis.

The following map will provide an exact idea about the geographical position of the sampling site: -

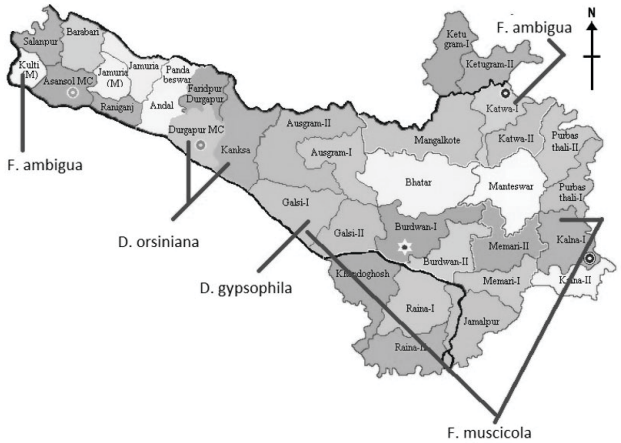

Figure 1: District Map of Burdwan showing a geographical spot of collection.

the pH of the water bodies was measured using pH paper (Merck Universal indicator, range1-10). The temperature of the water and the surrounding atmosphere were recorded using an immersion thermometer. The phytosociological associations were also recorded in the field record databook for further analysis.

Samples were taken on thin slides for study and drawings were made using drawing prism under low power (15x × 10x) and high power (15x × 40x) observation mode. The magnification and the length and breadth of the required portions were taken using stage and ocular micrometres by standardization technique. Sometimes the oil immersion lens was also brought into use for better results.

For the study of life cycle patterns and other biochemical analyses, the collected live algal samples were cultured through standard techniques. The cleaned samples were introduced into Petri dishes [(90 ×15) mm; Borosil] and culture tubes were properly sterilized by autoclaving them at 15-pound pressure for 15 minutes. The medium used was modified BG – 11[1] solidified by 3% agar. The cultures in the later stages were transferred to liquid culture (medium BG – 11) in polythene bags [(7 × 5) inch – Autoclavable] for optimum proliferation.

As the materials were collected from water bodies and moist soil surfaces the available Nitrogen, Phosphorus & Organic carbon was also measured at the site of collection following standard protocol.

RESULT &DISCUSSION

DICHOTHRIX[3]

Many sub-dichotomous falsely branched filaments together form a pulvinus, gelatinous thallus. Many trichomes at the base are present within a common sheath. Trichomes generally end in hair. Heterocysts were mostly basal but sometimes intercalary also.

Taxonomic Position: Cyanophyceae, Nostocales, Rivulariaceae.

Artificial Key to the species obtained during this investigation:

1 Trichome 6.5 – 7.5 µm wide and cells are always longer than broad…….....*D. gypsophila*

1 Trichome 11 – 12.5 µm wide and cells are broader than long…….....……. *D. orsiniana*

1. *Dichothrixgypsophila*[3]; (Fig. – 2; A)

The thallus is made up of pseudo dichotomously branched filaments. Filament sheathed, prostrate part and erect parts

are morphologically dissimilar. Branching false with heterocysts at the base of the trichome. Cells are sub-spherical to cylindrical. Trichome 6.5µm – 7.5µm broad with sheath and gradually tapering from base to apex.

Habitat – Obtained from Galsi area [Sample No. SC – 101 and 103 (pH 7.5 & Temperature 25°C) dated 23/11/2020] on other aquatic plants and submerged plastic bags as the tuft of dark-green to yellowish-green algal mass.

Discussion about the taxa: -This is the first report of the taxon from this part of India. Since the first report by Bornen&Flahault 1886, the taxa retained its taxonomic identity and according to available reports it has never been assigned as different taxa by any other worker. Thus, it is easily understandable that the taxa possess a very stable structure and adapted to varied environmental conditions efficiently.

2. *Dichothrixorsiniana*[3]; (Fig. – 2; B)

The thallus is made up of profusely and falsely branched trichomes. Trichome made of sub-spherical cells with 11µm – 12.5µm thickness. Heterocysts terminal and basal trichome sheathed and sheath very thick with open at the apical portion.

Habitat – Obtained from Budbud area [Sample No. SC – 113 (pH 6.5 & Temperature 15°C) dated 23/12/2019] in a rice field as slimy green algal mass and from Durgapur area [Sample No. SC – 133 (pH 6.5 & Temperature 20°C) dated 05/02/2020] in a sewage canal carrying industrial wastewater. But in both cases, the alga was found to occur as benthic material on either submerged higher plant leaves or waste products dumped by a human.

Earlier reports from India: Bombay[6]; Sikkim[7]

Discussion about the taxa: - This is the first report of this taxon from West Bengal. Like many other taxa under the genus *Dichothrix*, this taxa also was able to sustain different environmental changes as evident from the consistency of morphological attributes throughout its existence on earth.

FISCHERELLA[5]

Filamentous, filaments branched. The filament is generally made up of a single row of cells but sometimes maybe bi- or tri-layered too. The cells of the prostate portion are spherical to sub-spherical in outline and the branches generally unilateral are made up of elongated cells. The sheath of the prostrate and the older portion of the filament is very thick, but the branches have a thin sheath. Heterocysts intercalary and present on both prostrate parts and branches.

Taxonomic Position: Cyanophyceae, Stigonematales, Fischerellaceae.

Artificial Key to the species obtained during this investigation:

1 Cell of the prostrate part of the trichome is 6 - 7 µm wide and branches gradually tapering…..…… *F. ambigua*

1 Cell of the prostrate part of the trichome is 9.5 – 10.5 µm wide, branches uniformly broad……..…… *F. muscicola*

1. *Fischerellaambigua*[5]; (Fig. – 2; C)

Trichome branched, covered by a thick mucilaginous sheath. The cells of the prostrate part are bi-layered and that of the branch is uni-layered. Cells of the prostrate part are spherical in outline with 6µm - 7µm in diameter and that of the branches 3µm – 4.5µm broad. The cells of the branch are elongated and gradually taper towards the apex. Heterocysts intercalary and present on both prostrate and erect parts.

Habitat – Found to grow on the moist and clayed surface of the sewage canal in the Barakar area [Sample No. SC – 159 (pH 6.5 & Temperature 15°C) dated 16/12/2019] near a market area and from Katwa [Sample No. SC – 167 (pH 7.5 & Temperature 32°C) dated 22/08/2020] in rice field as the tuft of blue-green algal mass.

Discussion about the taxa: This is the first report of the taxon from India. It is presently considered a valid taxon from the taxonomical viewpoint. This taxon is often being confused with species of *Scytonema* and as it is very rare in occurrence it was never reported from India before this report, according to the available literature.

2. *Fischerellamuscicola*[5]; (Fig. – 2; D)

Trichome branched, branches arise from one side of the prostate part, branches dimorphic. Cells of the prostrate part are spherical with 9.5µm – 10.5µm in diameter. Cells of the erect part are elongated 6µm – 6.6µm broad. Trichome sheathed, the sheath was hyaline and thin. Heterocysts intercalary and present in both prostrate and erect parts.

Habitat – Obtained from Kalna area [Sample No. SC – 98 (pH 7.5 & Temperature 16°C) dated 28/11/2020] in a *Chorchorus* retting water body as green, thin film on the moist soil surface and from Galsi area [Sample No. SC – 101 & 105 (pH 7 & Temperature 25°C) dated 23/12/2020] amongst other semi-aquatic plants in a roadside canal.

Discussion about the taxa: Previously these taxa were reported from Faridpur, Bengal [Presently in Bangladesh][8] and Allahabad[9]. So though this taxon is very rare and restricted (habitat wise) in occurrence the author could not claim this report as first from India but it may easily be claimed as the first report from this part of India.

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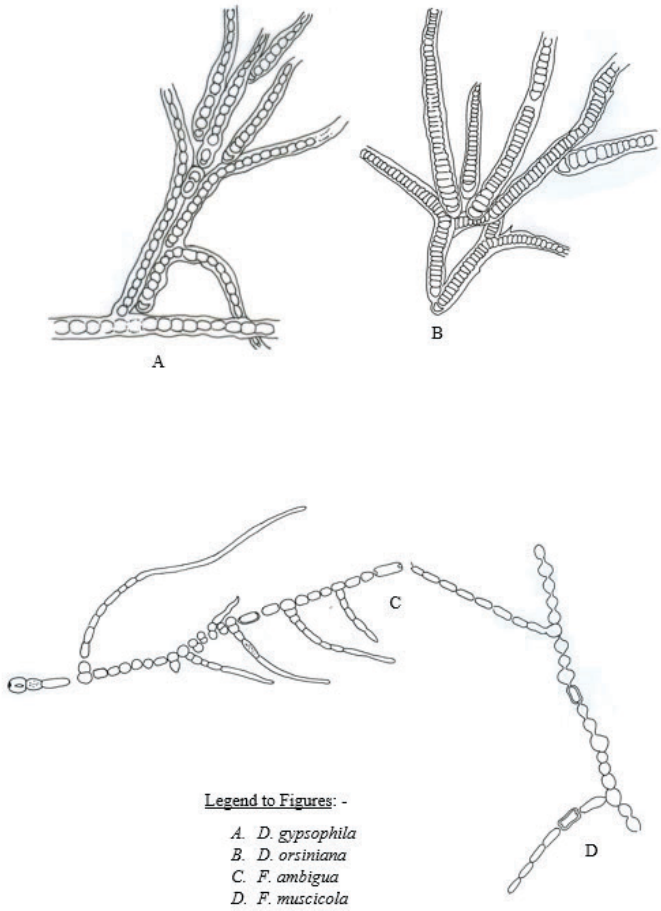

Figure 2