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DISTRIBUTIONAL PATTERN OF NITROGEN FIXING CYANOBACTERIA IN RICE FIELDS OF BANGLADESH

Z.N.T. Begum, Zahed U.M. Khan[1], R. Mandal[2] and M.Z. Hossain

Department of Botany, University of Dhaka,
Dhaka-1000, Bangladesh.

ABSTRACT

Ninety three cyanobacterial forms belonging to 32 genera were recorded from 58 rice fields of Bangladesh. The most abundant nitrogen fixing cyanobacteria were the species of *Nostoc, Calothrix, Hapalosiphon* and *Fischerella*. Generally *Calothrix marchica, Nostoc linckia* were well represented and distributed in all the districts. Among non-heterocystous forms, species of *Plectonema, Phormidium, Gloeocapsa* and *Chroococcus* were recorded in most of the samples. About fifty per cent of the total recorded cyanobacteria were found to be heterocystous. The range of pH observed was 5.8 - 7.8.

INTRODUCTION

The importance of cyanobacteria in improving the soil structure and fertility is well known (Fay, 1983). It has been reported that about 20-30 kg N/ha can be supplemented by algalization under differrent agroclimatic conditions (Roger and Kulasooriya, 1980; Venkataraman, 1981; Goyal, 1982). However, the success of algalization depends largely on the efficiency of the cyanobacterial forms to adapt to the ecological conditions of the soil so that they can survive, establish and colonize the soil in a reasonable time. Thus, it is important to survey and select the indigenous cyanobacterial strains. With this view, an attempt was made to survey the promising strains of nitrogen fixing cyanobacteria from 58 rice fields of Bangladesh.

MATERIALS AND METHODS

Fifty eight samples of surface soil (0-5 cm) from the rice fields of 27 districts under 4 divisions of Bangladesh were collected. Each sample was a composite sample of 5 sub-samples. Distributional pattern of cyanobacteria in the soil samples was studied from their growth in enrichment cultures (Patil and Satav, 1986) using Fogg's medium (Fogg, 1949). The pH of the soil was determined by Corning pH meter.

The cyanobacterial forms in the enrichment cultures were identified with the help of literature (Desikachary, 1959; Islam and Uddin, 1973; Islam and

[1]Department of Botany, Jahangirnagar University, Savar, Dhaka, Bangladesh.
[2]Department of Soil Science, University of Dhaka, Dhaka-1000, Bangladesh.

Begum, 1981a, 1981b). The relative abundance of different taxa was expressed in a qualitative scale (Sardeshpande and Goyal, 1981) of dominant (D), very common (VC), common (C), rare (R) and very rare (VR) respectively.

RESULTS AND DISCUSSION

The distributional pattern of cyanobacteria has been presented in Table 1. The data show that species of *Nostoc, Fischerella, Plectonema* and *Phormidium* are the most widely distributed forms. Similar results have been reported earlier from the rice fields of Bangladesh (Islam and Uddin, 1978a, 1978b; Bhuiya *et al.*, 1981; Khan and Venkataraman, 1991). Predominance of *Nostoc* spp. in most of the soil samples (Table 1) happens to be a common observation (Venkataraman, 1975, Okuda and Yamaguchi, 1956). Khan and Venkataraman (1991) observed that *Nostoc* was common in all the 9 soil samples and dominant in most of them. Next to *Nostoc, Fischerella* spp. were either dominant or common in maximum soil samples. In India, Kolte (1985) reported that *Fischerella* was one of the most common edaphic nitrogen fixing cyanobacterium. Next to *Fischerella, Hapalosiphon* spp. were common in most of the soils. *Fischerella* spp. were found to be dominant, very common and common in 7, 4 and 12 samples respectively. Similarly, the common occurrence of *Hapalosiphon* was also reported in the soils of Bangladesh (Islam and Uddin, 1978b; Islam and Begum, 1981a and b; Khan and Venkataraman, 1991) and India (Patil and Satav, 1986). Comparatively wider distribution of *Calothrix* observed during the present study is close to that reported earlier from the soils of Bangladesh (Islam and Uddin, 1973).

The restricted distribution of *Tolypothrix, Nodularia* and *Anabaenopsis* is supported by the report of Kolte (1985) and Islam and Begum (1981a). The presence of *Stigonema* was recorded in only five samples. It was dominant in Zaflong sample, very common in Damuddha sample and common in one sample each from Zaflong, Damuddha, Bhuapur, Madhupur and Pungsha. Islam and Uddin (1978b) also reported the presence of this alga from soil surface. Among the non-heterocystous cyanobacteria, *Plectonema* and *Phormidium* were the most widely distributed forms. The former was common in 15, very common in 8 and dominant in 2 rice field soil samples and the latter was common in 17, very common in 3 and dominant in 4 rice samples. In addition, species of *Oscillatoria, Lyngbya* and *Gloeocapsa* were also found in different rice field soils. Khan and Venkataraman (1991) also reported the presence of these forms in the rice fields of Bangladesh. According to Stewart *et al.* (1979), some of the non-heterocystous cyanobacteria have the nitrogenase enzyme and can fix atmospheric nitrogen under certain conditions. From Figure 1, it is evident that about 50% of the total cyanobacteria were non-heterocystous. These non-heterocystous cyanobacteria may attain importance and contribute biologically fixed nitrogen under microaerophilic conditions of the sub-soil zone of the rice field.

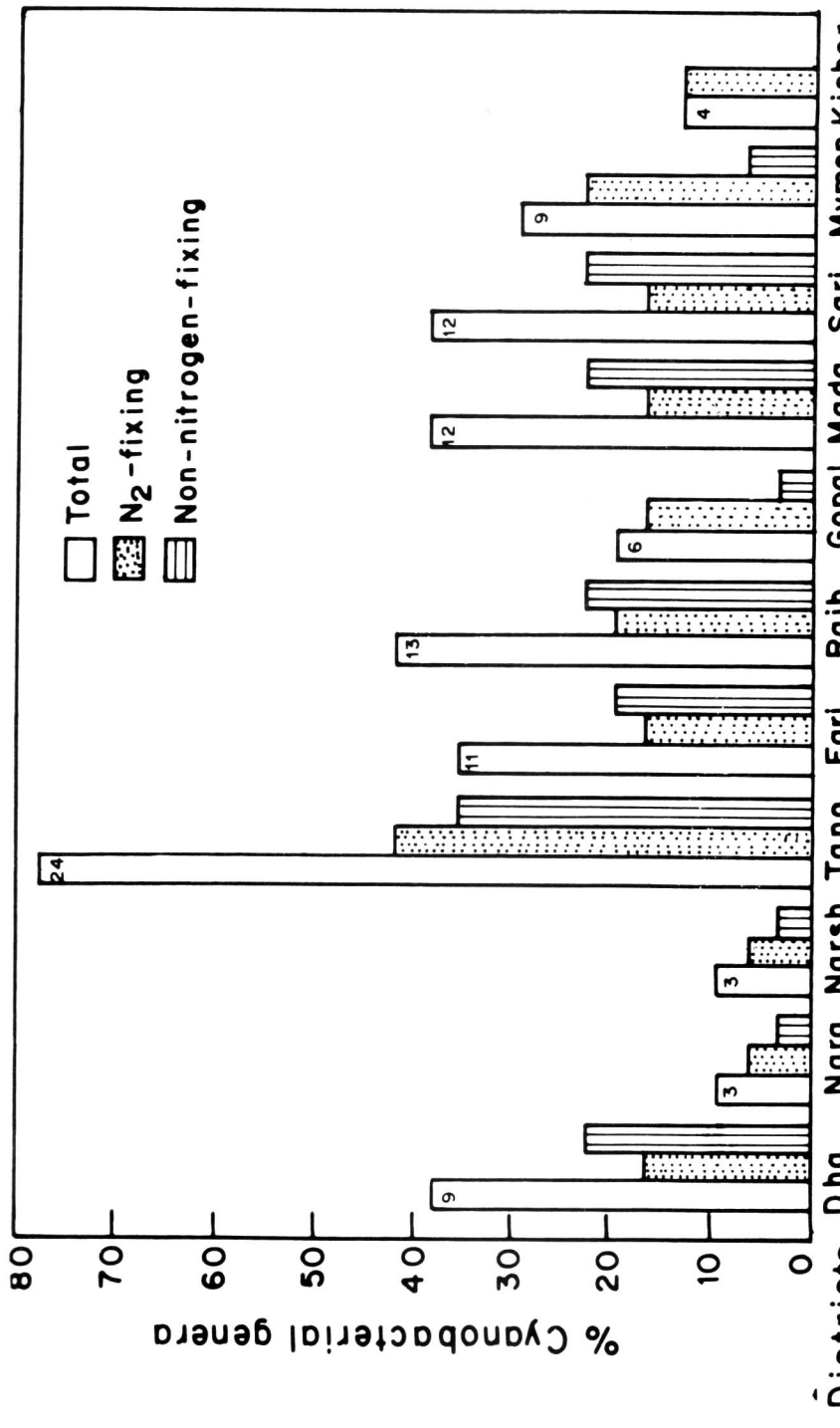

Fig. 1. Distribution of different cyanobacterial genera in 11 districts of Dhaka Division (Dha, Dhaka; Nara, Narayangong; Narsh, Narshingdhi; Tang, Tangail; Fari, Faridpur; Rajb, Rajbari; Gopal, Gopalgonj, Mada, Madaripur; Sari, Sariatpur, Mymen, Mymensingh; Kishor, Kishorgonj). Figures in the bar indicate number of cyanobacteria.

Table 1. Distributional pattern of Cyanobacteria in the rice field soils of Bangladesh.

Taxa	No. of samples showing their respective abundance				
	D	VC	C	R	VR
Microcystis aeruginosa	-	-	2	-	-
Chroococcus giganteus	-	-	2	-	-
C. macrococcus	-	-	1	-	1
C. pallidus	-	-	2	-	-
C. sp.	-	-	4	-	-
Gloeocapsa decorticans	-	-	2	2	-
G. pleurocapsoides	-	-	1	-	2
G. calcarea	-	-	1	1	1
G. punctata	-	-	3	-	1
G. sp.	-	-	6	-	-
Gloeothece. sp.	1	-	-	2	-
Aphanocapsa pulchra	-	-	1	-	-
A. biformis	-	-	2	-	-
A. sp.	-	-	1	-	-
Aphanothece sp.	-	-	3	-	1
Synechocystis pevalekii	-	-	1	-	3
S. aquatilis	-	-	2	-	-
Synechococcus aeruginosus	-	-	-	-	1
Myxosarcina sp.	-	-	-	1	-
Oscillatoria perornata	-	-	3	-	-
O. limosa	-	1	2	1	-
O. animalis	-	-	2	-	-
O. subbrevis	1	1	8	-	3
O. curviceps	-	-	2	-	-
O. proboscidea	1	-	1	-	-
O. chlorina	-	-	3	-	1
O. terebriformis	-	1	1	-	-
O. rubescens	-	-	1	-	-
O. acuminata	1	-	1	-	1
O. simplicissima	-	-	1	-	-
O. martini	-	-	2	-	1
Phormidium ambiguum	-	-	2	-	-
Phormidium sp.	2	8	15	-	2
Lyngbya truncicola	3	1	2	-	1
L. ceylanica	1	-	-	-	-
L. dendrobia	1	-	2	-	-
L. martensiana	1	1	1	-	1
L. connecteus	-	1	-	-	-
Lyngbya sp.	1	7	-	1	1
Schizothrix lamyi	-	1	-	1	-
Microcoleus sp.	-	-	2	1	1
Anabaenopsis tanganyikae	-	-	-	-	1
Cylindrospermum muscicola	-	-	1	-	2
Nostoc punctiforme	-	-	1	-	-
N. paludosum	4	-	-	-	-
N. linckia	2	4	4	-	1

Table 1. Contd....

Taxa	No. of samples showing their respective abundance				
	D	VC	C	R	VR
N. piscinale	2	1	2	-	2
N. carneum	-	-	2	-	-
N. commune	-	-	1	-	-
N. hatei	-	-	2	-	-
Nostoc sp.	5	5	4	-	2
Anabaena oryzae	1	-	3	-	-
A. orientalis	-	1	1	-	-
A. iyengarii	-	1	1	-	-
A. laxa	1	-	-	-	-
A. fertilissima	-	-	-	-	1
Anabaena sp.	-	-	1	1	3
Microchaete tenera	-	-	3	2	-
Pseudoanabaena sp.	-	-	-	3	5
Nodularia sp.	-	-	-	-	1
Raphidiopsis indica	-	-	1	-	-
Aulosira bombayensis	-	-	1	-	-
A. aenigmatica	3	-	2	-	1
A. pseudoramosa	-	-	1	-	-
A. implexa	-	-	1	-	-
A. fertilissima	-	-	-	-	1
Aulosira sp.	-	-	2	1	-
Plectonema sp.	4	3	17	1	-
Scytonema hofmanii	1	-	1	-	-
S. burmanicum	-	-	1	-	-
S. mirabile	1	-	-	-	1
S. schmidtii	-	-	1	-	-
Scytonema sp.	2	-	3	-	-
Tolypothix byssoidea	-	-	2	-	1
T. fragilis	-	-	1	-	-
T. distorta	2	1	1	-	-
Calothrix crustacea	-	-	3	-	-
C. javanica	1	-	-	-	-
C. wembaerensis	1	-	-	-	-
C. elenkinii	-	-	4	3	1
C. parietina	-	-	-	-	1
C. marchica	1	4	7	-	3
Calothrix sp.	2	2	1	3	1
Hapalosiphon welwitschii	5	-	7	1	1
H. fontinalis	-	-	2	-	-
H. stuhlmannii	-	-	-	1	-
Hapalosiphon sp.	2	1	2	-	-
Mastgocoleus testarum	1	1	1	-	2
Westiellopsis prolifica	4	2	1	-	-
Fischerella muscicola	1	-	-	-	-
Fischerella ambigua	1	3	1	-	-
Fischerella sp.	7	4	12	1	1
Stigonema sp.	1	1	3	-	1

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