



BIODIVERSITY OF CYANOBACTERIA IN RICE FIELDS OF TAMIL NADU

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ABSTRACT

In the present investigation, the phenotypic diversity of cyanobacteria in rice fields were explored and identified in Tamil Nadu. This investigation was undertaken to characterize the abundance and genera-wise diversity of cyanobacteria in the rice rhizosphere. The diversity of cyanobacteria in rice fields were studied in seven different districts like Perambalur, Trichy, Villupuram, Cuddalore, Coimbatore, Tanjore and Namakkal. Totally 19 species of cyanobacteria distributed in seven different districts were recorded. Among the districts, samples from Perambalur district recorded the maximum number of species (7) followed by Trichy (4), Coimbatore (1), Tanjore (3), Namakkal (1), Cuddalore (1) and Villupuram (2). The abundance of heterocystous cyanobacteria was recorded only in Trichy district. Totally 13 genera of cyanobacteria were seen commonly in the rice field samples like *Anabaena*, *Phormidium*, *Cylindrospermum*, *Calothrix*, *Lyngbya*, *Tolypothrix*, *Fischerella* and *Pleurocapsa*. The abundance of cyanobacteria in rice fields was due to favourable contents of oxidizable organic matter and abundant nutrients such as nitrates and phosphates with less dissolved oxygen.

KEY WORDS: Cyanobacteria, Rice, Diversity, Tamil Nadu.

INTRODUCTION

Cyanobacteria are known to cohabitate with rice, proliferating as floating assemblages on the soil-water surface and this has been exploited in agriculture through their specific inoculation as nitrogen supplementing biofertilizers in paddy fields, especially in several countries of South East Asia. Cyanobacteria are increasingly used as bio-fertilizers for rice (Venkataraman, 1972). Species of *Nostoc*, *Anabaena*, *Tolypothrix*, *Aulosira*, *Cylindrospermum*, *Scytonema*, *Westiellopsis* and several other genera are widespread in Indian rice field soils and are known to contribute significantly to their fertility (Nayak *et al.*, 2004). Efficient nitrogen fixing strain like *Nostoc linkia*, *Anabaena variabilis*, *Aulosira fertilissima*, *Calothrix* sp., *Tolypothrix* sp., and *Scytonema* sp. were identified from various agro-ecological regions and utilized for rice production (Prasad and Prasad, 2001). After water, nitrogen is the second limiting factor for plant growth in many fields and deficiency of this element is met by fertilizers (Malik *et al.*, 2001). Cyanobacteria play an important role in maintenance and build-up of soil fertility, consequently increasing rice growth and yield as a natural biofertilizer (Song *et al.*, 2005). Cyanobacterial communities were composed of the morphologically defined genera *Anabaena*, *Nostoc*, *Aulosira*, *Cylindrospermum*, *Gloeotrichia*, *Rivularia* and *Tolypothrix* of the order Nostocales; *Oscillatoria*, *Lyngbya* and *Phormidium* of the Oscillatoriales; *Fischerella* and *Hapalosiphon* of Stigonematales; and *Aphanothece* and *Gloeothece* of the Chroococcales in the rice fields of Eastern Uttar Pradesh, India. Blue green algae (BGA) are photosynthetic nitrogen fixers and are free living. They are found in abundance in India. They too add growth promoting substances including vitamin B12, improve the

soil's aeration and water holding capacity and add to biomass when decomposed after life cycle. Low salinity favored the presence of heterocystous cyanobacteria, while very high salinity mainly supported the growth of non-heterocystous genera. High nitrogen content in the low salt soils is proposed to be a result of reduced ammonia volatilization compared to the high salt soils. Although many environmental factors could potentially determine the microbial community present in these multidimensional ecosystems, changes in the diversity of cyanobacteria in rice fields was correlated to salinity (Srivastava *et al.*, 2009).

An efficient nitrogen fixing and phosphate solubilizing cyanobacteria will be very useful for the cultivation of rice where bound phosphates remain unavailable. However, in recent years, an urgent need has felt to address inherent deficiencies, which have limited their extensive exploitation in diverse rice ecologies and soil types. In a country such as India, rice is grown under diverse ecologies. Therefore, this investigation was aimed at quantification of the cyanobacterial diversity in terms of population counts, relative generic abundance, and their correlation and isolation of dominant genera from diverse rice ecologies of India.

MATERIALS & METHODS***Collection of soil samples, isolation and enumeration of cyanobacteria***

Soil samples collected from different districts rice fields and irrigation channel were utilized for enrichment studies in BG-11 medium with/without nitrogen supplementation. Enumeration of populations was carried out by MPN (Most Probable Number) technique and tabulated for each site under the various locations. The enrichment flasks and

MPN tubes were regularly monitored for growth and observed microscopically. Standard plating/streaking techniques were used for isolation and purification of cyanobacterial strains (Stanier *et al.*, 1971)

Identification and purification of cyanobacteria

The growth pattern and morphological examination of the cyanobacterial strains was carried out at different stages of growth in nitrogen-free liquid and solid (agar) BG-11 medium. The strains were viewed under a light microscope and the nature of filaments and the shape and size of vegetative cells, heterocysts and akinetes, were analysed and assigned to different genera, using the keys of Desikachary (1959).

RESULTS & DISCUSSION

The food production required to be enhanced to provide food and nutritional security to the growing population. In order to retain the farmers especially the younger generation to take up agriculture as a profession, the income from the farm holdings required to be increased considerably. Major efforts are required to increase the productivity of rice crop by overcoming the various challenges such as; erratic monsoon rains, soil with low nutrient and organic contents /poor water holding capacity, soil and water erosion, etc. In respect of rice crop, the crop cultivation is taken up in two (Kharif and Rabi) seasons annually under irrigated and Rain-fed conditions in Tamil Nadu. Hence to achieve sustainable development and break-through in agricultural production, continuous concentration on technical advancement, input supply, credit and market supports are required. In the present investigation soil samples were collected from seven locations like Perambalur, Trichy, Coimbatore, Tanjore, Villupuram, Cuddalore and Namakkal. Among the 19 isolates 18 were non- heterocystous and one was heterocystous. The diversity of the genera observed under light microscope was presented in Fig. 2. The blue green algae (cyanobacteria) are capable of fixing the atmospheric nitrogen and convert it into an available form of ammonium required for plant growth. Dominant nitrogen-fixer blue-green algae are *Anabaena*, *Nostoc*, *Aulosira*, *Calothrix*, *Plectonema* etc. Blue-green algae have the abilities of photosynthesis as well as biological nitrogen fixation. Cyanobacteria are one of the major components of the nitrogen fixing biomass in paddy fields. The agricultural importance of cyanobacteria in rice cultivation is directly related with their ability to fix nitrogen and other positive effects for plants and soil. Bio-fertilizers are eco-friendly and have been proved to be effective and economical alternate of chemical fertilizers with lesser input of capital and energy (Sahu *et al.*, 2012). The trophic independence from carbon and nitrogen, together with a great adaptability to environmental variations, enables cyanobacteria to be ubiquitous. Their

structural-functional flexibility provides them with not only great versatility, but also makes them among the most successful in extreme environments including high temperatures, high levels of UV light, and high salinity and inhabit a wide range of environments. Their role in the soil ecosystem is manifold, the most important consequences being the fixation of nitrogen and carbon, besides promoting release of nutrients and reducing the rate of loss of water and soil through erosion. Cyanobacteria or Blue green algae (BGA) are a group of microorganism that can fix the atmospheric nitrogen. BGA can adapt to various soil types and environment which has made it cosmopolitan in distribution.

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