CHAPTER - II

REVIEW OF LITERATURE
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During the first half of the 20th century, the Indian workers had started to take active interest in the studies of algae. The studies on algae have been primarily focussed to enumerate their occurrence, flora, taxonomy, morphological characteristics and life cycles. Algal forms have been studied more systematically under Prof. M.O.P. Iyengar (1920, 1958) and later by Prof. Y. D Bharadwaja (1933a & b) of Varanasi and by Prof. T.V Desikachary (1945, 1946 a& b, 1954 and 1959) of Madras.

The initiation of algal research at different institutions viz, (a) Indian Agricultural Research Institute, New Delhi (b) the central Rice Research institute, Cuttack (c) School of Algology, Banaras Hindu University (d) Advance center of Botanical Research, Algal section, Madras etc. have brought to light many of the positive implications of algae as a biological input in rice cultivations. The setting up of a National Facility on Blue-green Algae at IARI, Delhi and another National Facility on Marine cyanobacteria at Trichy by DBT has brought to focus the need in conserving algal genetic resources to do more systematic work on its potential and application to benefit humans. This will not be possible without a clear understanding of the ecology and occurrence of these algal forms to isolate a naturally occurring “super strain” for commercial production. The studies on the ecology of algal forms have been more comprehensive on cyanobacterial form which fix nitrogen and has helped in the transfer of blue-green algal technology for large-scale field application.

Mitra (1951) reported frequent occurrence of *Microcoleus* and *Nostoc* in Indian soils. Both fresh water and terrestrial members of Cyanophyceae had been well documented by Desikachary (1959) His monographs included 81 genera and 493 species from Indian territory. Since his publications, considerable work had been carried out by
many Indian workers on occurrence, habitat, dominance, seasonal fluctuations, flora, distribution, diversity and nitrogen fixation. Varma (1959) studied on the succession of marine algae on a substratum in Palk Bay.

Singh (1961) observed that in U.P, *Aulosira fertilissima* growing abundantly in rice fields perennated in the form of spores during the desiccation period of rice cultivation cycle. As the soil dried up the dominance of mucilaginous colonies of *Nostoc* and *Cylindrospermum* were seen in the later stages of rice cultivation (Pandey 1965). Mitra (1961) reported that BGA accounted for more than half of the total number of algal genera found in Indian soil. Lakshminarayan (1962, 1963) recorded 344 algae from U.P, belonging to Chlorophyceae, Myxophyceae and Bacillariophyceae.

Different workers had reported algal flora from various Indian states (SubbaRaju 1963; Srinivasan 1963; Pandey 1965; Aiyar 1965; SubbaRaju 1967; Agarkar 1975; Pal 1975; Pandhol and Grover 1976; Prasad and Mehrotra 1977; Goyal 1982 b) and Prasad and Shrivastava (1965) had reports of thermal algae. Amma *et al.* (1966) reported the presence of species of *Nostoc* and *Anabaena* even in the peaty soils from Kuttanad in Kerala.

A number of workers had reported presence of BGA from different habitats of India (Srivastava 1967; Agarkar 1967; Khurana and Venkataraman 1968; Goyal 1969; Goyal and Venkataraman 1971; Padmaja 1972; Chacko 1972; Laloraya and Mitra 1973; Bendre and Kumar 1975; Sinha and Mukherjee 1975; Tiwari and Pandey 1976; Prasad and Malhotra 1980; Mukhopadhyay and Chatterjee 1981; Mahajan and Mahajan 1989; Dubey 1993; Singh 2001). Goyal (1969) reported some forms like *Chroococcus*, *Microcystis* and *Phormidium* to be endemic in some particular areas of Trivandrum. Tiwari (1972), from taxonomic consideration studied non-heterocystous blue green algae from the paddy field soils.

While studying the distribution of edaphic algae, King and Ward (1977) came to the
conclusion that the diversity in blue green algal flora was favoured by soil disturbance. Singh (1961) studied nitrogen economy of rice field soils in relation to nitrogen fixation by BGA and Azolla. Singh (1978) reported the succession of BGA on certain sites of Varanasi.

A detailed account of survey of edaphic algae of Indian rice fields was given by Venkataraman (1981 a). Bongale (1981) reported that lateritic and black soils had poor algal component than the sandy soils of Karnataka. Devi and Boissya (1981) reported the availability of *Phormidium* species from the paddy fields of Assam. Sardeshpande and Goyal (1981) reported the presence of BGA from the paddy fields of Konkan region of Maharashtra. Goyal (1982 a) gave a detailed review of the role of BGA in rice cultivation with particular reference to India.

Predominance of BGA in soil and cultivated land had been reported by various workers from different parts of India (Goyal 1982 b; Marathe and Reddy 1982; Pal and Santra 1982; Chatterjee and Chatterjee 1983; Barhate and Tarar 1983; Jha et al. 1986; Patil and Satav 1986; Kolte and Goyal 1986; Anand and Revathi 1987; Hedge and Malammanavar 1988; Singh and Bisoi 1989; Rather and Mir 1989; Goyal 1989; Mahajan and Mahajan 1989; Padhey et al. 1992; Begum et al. 1993; Shaji and Panikhar 1994; Pandey et al. 1998 a; Sen 2000; Tiwari et al. 2001; Singh 2001). Nayak et al. (2001) studied the floristic abundance and relative distribution of different cyanobacterial genera in rice field soil at different crop growth stages. Singh (2001) studied the occurrence of cyanobacteria in different habitats in and around Rampur district of UP. The algal flora was found to dominate by heterocystous cyanobacteria. Shivaram and Shivappa Shetty (1988) also reported predominance of BGA from the rice fields of the Cauvery command area in Karnataka state.

Anand and Subramaniam (1994) studied the succession and distribution of BGA in rice fields of Maduravoyal in Tamil Nadu. Mishra et al. (2005) reported the dominance of cyanobacteria belonging to the family Rivulariaceae in the rice field soils of district Allahabad
and diversity reportedly existed among these with respect to physiological parameters.

Anand et al. (1995) reported the distribution of various BGA in rice fields under different cultivation practices in Kerala state where localized taxa were found. Madhusoodanan and Dominic (1995) studied the variations in the diversity of blue-green algae in a paddy field during cultivation. Maximum species diversity and abundance occurred during tillering period. Singh et al. (1995 b) examined the cyanobacterial isolates obtained from alkaline soils and their response to changes in pH. Das (2002) studied cyanobacterial diversity in rice field soil of Sambalpur district of Orissa.

Sahu et al. (1996) recorded maximum number of Nostoc species which confined to irrigated and lowland areas. Species of Calothrix, Aulosira and Westiellopsis showed their wider distribution in different agroclimatic zones. Sharma and Naik (1996) studied the presence of heterocystous and non-heterocystous forms of cyanobacteria in M.P. In an aerobiological study in Nagpur, Likhitkar and Tartar (1996) found that cyanophycean forms were dominant as compared to other groups. Further, they reported that the highest frequency occurred of aeroalgae in the winter season (October - December).

Jha et al. (1998) reported remarkable diversity in the population of cyanobacteria from different depths in a newly dug pond and concluded that BGA population decreased with increasing depths. While studying the physiochemical characteristics of Fateh Sagar Lake in Udaipur, Pandey et al. (1998 b) came to the conclusion that with seasonal variation, considerable diversity of algal population occurred. Sen and Gupta (1998) recorded 24 species of genus Oscillatoria from the lower Gangetic plains of West Bengal.

Tiwari et al. (1999) reported the distribution of BGA in different locations of arid zone of Rajasthan. Singh et al. (2000) observed no significant variations in the distributional pattern of cyanobacterial forms. Kumawat and Jawale (2001) collected eight taxa of Spirulina from fishponds at Angale and Jalgoan districts of Maharashtra state. Ara et al. (2002) recorded 101 cyanobacterial taxa belonging to 25 genera from
the agro eco-system of Kashmir valley. Filamentous cyanobacterial diversity was maximum in rice fields. Pandey (2002) investigated the soil inhabiting cyanobacteria from arable lands of southern Rajasthan and concluded that the distribution of cyanobacteria was controlled by pH of the soil, maximum diversity being in diazotroph. *Oscillatoria limnetica* was found to be dominant in soil with pH above 8.5.

Satapathy and Adhikary (1993) surveyed the occurrence of various forms on the rock surfaces of different temples and caves of Bhubaneswar, Puri and Konark. They reported that the species of *Scytonema* and *Tolyphrix* were dominant forming blackish brown crust on the rock surfaces even during mid-summer months.


Ecological studies on algae isolated from effluents of oil refinery, fertilizer factories and breweries were done by Kumar et al. (1974), Rai and Kumar (1976 a & b, 1977), Somasekhar and Ramaswamy (1983) and Sahai et al. (1985). Retardation of algal growth by petroleum hydrocarbons and stimulations of their growth in aquous extracts of crude oils had been demonstrated by many workers (Vandermeulen and Ahern 1976; Premila and Rao 1997).

Abundant algal species were recorded from organically polluted sites of river Ganga (Bilgrami et al. 1985). Premila and Rao (1997) studied the effect of sewage and salinity on the growth of *Oscillatoria nigroviridis*. Pal et al. (1992) studied the organic pollution level of Hugli estuary using algae as pollution monitors. Mohapatra and Mohanti (1992) determined the water quality in Bindusagar and Kedarguri tanks by using *Chlorella vulgaris* and *Anabaena dolio tum* as pollution indicators growing in the tank. Sarojini (1996) studied the composition, abundance and distribution of phytoplankton in sewage and receiving
harbour water at Vishakapatnam, where the planktonic Cyanophyceae, Chlorophyceae and Euglenophyceae grew abundantly facing nutrients enrichment due to sewage inflow.

Not much work has so far been done on the BGA available in Assam and its neighbouring states. Only in the last part of the century little work was done. Biswas (1945) reported the algal flora of Bengal and Assam. Devi and Boissya (1981) reported Phormidium species from the paddy fields of Assam. Hazarika and Gogoi (1985) recorded BGA in the hot springs of Nambor forest of Assam. Deka and Bordoloi (1991), Saikia and Bordoloi (1994) reported some BGA from the rice field of Assam. Singh et al. (1996) studied BGA in acidic pH (5.0-6.5) rice field soil samples of Mizoram and identified 48 taxa belonging to 27 genera which were distributed in upland, low land, jhum land and terraced land where temperature ranged from 11°C - 29°C. The dominant BGA recorded were from the genera Anabaena, Calothrix, Cylindrospermum, Hapalosiphon, Nostoc, Tolypothrix and Westiellopsis. Singh et al. (1997 a), encountered with 83 species of BGA belonging to 25 genera, some of which were distributed among highly acidic pH (3.8) soil samples of Arunachal Pradesh. Order Nostocales emerged with the highest number of BGA contained in 5 families. Singh et al. (1997 b, 1997 c) studied the BGA from the rice field soils of Nagaland and Tripura. Ahmed et al. (1999) studied BGA in rice field soils of Nagaon sub division. Rout and Dey (1999) studied algal flora from Irongmara (Barak valley, Assam). They found that increased rice yield was correlated with higher algal bio diversity and organic carbon content of the soil. Devi et al. (1999) studied field soils BGA of Manipur and Nandi and Rout (2000) studied algal flora of different habitats of Silchar (Assam). Hazarika et al. (2001) studied the BGA from the rice fields of Lakhimpur district of Assam. Ahmed (2001) worked on the distributional pattern of BGA in rice field soils of Hojai sub division of Assam. Hazarika et al. (2002) reported 17 species of Oscillatoria from Ranganadi and its adjoining areas of Lakhimpur district of Assam.

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