Chapter - 5

DISCUSSION
Biofertilizers are one of the important components of integrated nutrient management. They are effective, ecofriendly and renewable source of plant nutrients to supplement chemical fertilizers in a sustainable agricultural system. Recently, the biofertilizer production technology has attracted much attention of the small and large scale producers because of its simple and cost effective nature. In the present investigation, emphasis is given to develop a composite inoculum that may be used as biofertilizer to accelerate the application of BGA biofertilizer in a more effective way in Morigaon District, Assam. The findings of the present investigation have been discussed here, which is based on the support of earlier reports on this field and other allied areas.

5.1 ISOLATION, CHARACTERIZATION AND DISTRIBUTION OF BGA

Altogether 198 rice field soils were collected and 77 representative samples were obtained for isolation of BGA. The results showed diverse communities of BGA from these soils. Out of total 236 BGA isolates from the district, only 18 genera with 38 species were taxonomically identified and characterized.

The findings of the present investigation showed that Morigaon agricultural circle (C3) harbours maximum species (25Nos.) of BGA followed by Gossorbori circle (C2) and Moirabari circle (C12, 16 Nos.) and the lowest species (8 Nos.) encountered were from Jagibhakatgaon circle (C9). It further reported the dominancy of Nostoc followed by Anabaena, Cylindrosporum and others from all 12 circles so far studied. The frequency distribution confirms the dominancy of Nostoc and Anabaena as 100% i.e. all soils under
study contained *Nostoc* followed by *Anabaena*. Apart from these, some rare species like *Spirulina gigantea* was only encountered from Jaluguti circle (C₄) whereas the species of *Stigonema* were isolated only from Rajamayang circle (C₁₁). Compared to species distribution, species of *A. torulosa* occupied highest frequency from 12 agricultural circles than other species of *Anabaena*. Similarly, among *Nostoc* species, *N. commune* was mostly dominant species from these soils.

The above results focused diverse communities of BGA from rice field soils of Morigaon district of Assam. The results corroborate with the findings of Singh (1961), Venkataraman (1976) and Santra (1987), where they reported that rice fields harbour diverse communities of BGA such as *Anabaena, Aulosira, Calothrix, Cylindrospermum, Gloeotrichia, Nostoc, Rivularia, Scytonema* and *Tolypothrix*. However, the dominant species may vary depending on pH, temperature, light intensity and soil type. A number of reports exist on the population succession of rice field BGA (Singh and Singh 1989; Kannaiyan 1990; Santra 1993), which is one of the important factors for community diversion in an area. The present investigation showed the dominance of *Anabaena* and *Nostoc* in study area. Singh (1978) also conducted a similar survey on the farms of Central Rice Research Institute and reported the dominance of *Aphanthece, Anabaena, Aulosira, Cylindrospermum, Gloeotrichia* and *Nostoc*. Similar report also exhibited by Sardespande and Goyal (1981) about the dominance of *Anabaena, Aulosira, Calothrix* and *Nostoc* in other areas of India. The dominancy of *Anabaena* and *Nostoc* from different rice fields of Assam, Kerela, Meghalaya, Mizoram, Nagaland, Orissa, Tamil Nadu, West Bengal, has also been reported (Vankataramman 1975; Singh and Bisoyi 1989; Sahu *et al.* 1996; Dorycanta 1996; Devi 1997; Singh *et al.* 1999; Ahmed 1999). However, the variation and distribution of the species may be attributed to the different ecological factors of soil. In the edaphic factor, pH of soil is
the most influencing one. The report of Roger and Reynaud (1977) showed the positive relation between algal growth and $pH$ where the optimum $pH$ for BGA growth in culture media ranges from 6.5 to 7.0. In spite of the presence of much higher acidic soil (3.3-6.8) in comparison to optimum, the study area shows the occurrence of diverse communities of BGA. This is in conformity with the earlier reports, which showed the isolation of many Cyanobacterial cultures from acid soils of Kerela having a $pH$ of 3.8 and Tamil Nadu (Madhusoodanan and Dominic 1995, 1999). Similar reports are also available from acid soils of different parts of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland and Tripura where *Anabaena, Aulosisa, Calothrix, Cylindrospermum, Hapalosiphon, Microcoleus, Nostoc, Nostocopsis, Tolypothrix, Westiellopsis* were isolated. The most dominant forms also exhibited wide variations in their population in different states of North East India which had also been reported earlier by many workers (Reddy et al. 1985; Deka and Bordoloi 1991; Singh et al. 1996, 1997a,b,c; Dorycanta 1996; Devi 1997; Ahmed 1999). It is revealed from the present findings that soil having similar $pH$ also exhibit different distribution pattern. The results showed that in some circles of the study area encountered sparse population of BGA whereas some circles showed dense population and some rare species were also isolated from Jaluguti and Rajamayang circle. It may be due to the cumulative effect of soil nutrient status mainly moisture, organic matter content, available N and available P. The soil nutrient status of the samples of study area revealed the variation in organic carbon, available N and available P. The organic carbon content was recorded from trace to 1.38% whereas available N content was recorded medium to high. On the other hand, phosphorus that plays a major role in distribution of BGA, ranged from trace to high. The combined effect of soil nutrient status on the distribution and variation of BGA in the present study corroborate with the report forwarded by Das and Verma (1966) who reported the
luxuriant growth of BGA in running water as well as stagnant water habitats. Goyal (1997) also reported that high moisture and water holding capacity encourage algal growth. Singh et al. (1998) correlated the growth and BNF efficiency of BGA with relative humidity, which is directly correlated primarily to the rainfall in the natural field condition. Cameron and Blank (1966) states that high organic matter content increases algal incidence through increasing the moisture content of the soil. It has been also reported that soil fertility, specially organic carbon, nitrogen and available phosphorus play a significant role in growth and distribution of BGA in rice field soils (Kannaiyan 1985; Venkataraman 1988). In the present investigation, ubiquitous distribution of some algae such as Anabaena and Nostoc almost in entire 12 circles of the study area could be attributed to their dominance over other BGA species.

5.2 SCREENING OF BGA

In the present investigation, the criteria considered for screening of BGA are

1) Biomass production
2) Total nitrogen content and
3) Chlorophyll content.

Growth of algal cultures expressed usually as the increase in biomass production indicates physiological and biochemical efficiency. Singh et al. (2001) reported that besides biomass production, growth of algal cultures expressed as the amount of nitrogen content vis-a-vis protein content of photosynthetic pigments such as chlorophyll ‘a’ is directly proportional to the nitrogen fixation efficiency. Thus, in the present investigation 32 numbers of BGA cultures irrespective of different isolates were selected for observation of biomass production.
It is important to note that in vitro biomass production is effected by the composition of media. Babu and Kannaiyan (1998) reported that among the different media, the BG 110 medium (Stanier et al. 1971) favoured maximum nitrogenase activity by Cyanobacterial cultures. Earlier Stanier et al. (1971) found the BG110 medium was very effective for substantial growth of heterocystous BGA. Heterocyst frequency is of immense importance to evaluate N$_2$ fixing ability of BGA. Because, heterocyst is a specialized cell where nitrogen fixation takes place and it has been illustrated that more is the heterocyst frequency more is the N$_2$ fixation (Flemming and Haselkorn 1973). This is also in conformity with the findings of Hill (1975) and Peters (1977), where increasing heterocyst frequency and nitrogen fixation rate was recorded higher from younger to older fronds of Azolla. So, to develop only heterocystous BGA, BG110 medium was used for in vitro biomass production and the result showed a wide variation of biomass production among the species and it ranged from 0.038 to 0.184 mg $100^{-1}$ ml. Hence, on the basis of screening criterion, the cultures showing 0.060 mg $100^{-1}$ ml biomass production and below were discarded along with some unicellular and non heterocystous algae. Some potent strains that produced maximum in vitro biomass were Gloeotrichia pilgeri (0.184mg $100^{-1}$ ml), Anabaena torulosa (0.147mg $100^{-1}$ ml), Anabaena fertilissima (0.142 mg $100^{-1}$ ml), Nostoc commune (0.134mg $100^{-1}$ ml), and Aulosira fertilissima (0.105mg $100^{-1}$ ml). Altogether 23 cultures were screened for further estimation. Nitrogen is a key nutrient in the environment and BGA constitutes a perpetual source of nitrogen due to their efficiency in nitrogen fixation. There are many reports about the extent of Blue Green Algal nitrogen fixation in an exceptionally high order and this nitrogen is fairly readily available for successful growth of rice (Singh 1976; Venkataraman 1982b, 1988). Thus, the estimation of total nitrogen content is taken as an important screening criterion among the selected cultures. The findings of the quantification of nitrogen fixation in terms of
total nitrogen content showed that some species viz. *Gloeotrichia pilgeri, Anabaena torulosa, Anabaena fertilissima, Aulosira fertilissima* and *Nostoc commune* not only produced maximum biomass but also contained maximum N content. The present study showed the range of total nitrogen content varies from 1.20 to 2.96%. The reason may be attributed to the species variation. This is in conformity with the findings of earlier workers. Ley (1992) in a report concluded that total N content in *Anabaena* and *Nostoc* varied considerably. Singh and Bisoyi (1989) also reported the wide variation of nitrogen fixation in terms of nitrogen content among the species of *Aulosira* and *Aphanothece*. Similarly, wide variation in N₂ fixation had also been reported among the species of some genus in rice fields of Andhra Pradesh and Assam (Suseela and Goyal 1995; Ahmed 1999). Thus, it is suitable to take the quantification of total nitrogen content as screening criterion, which help the selection of 19 nos. of species for further enumeration from 23 nos. of cultures in the present study.

Growth of an algal culture does not necessarily imply cell division, but cell division accompanies it. So, several cellular components can be used as a measure of biomass such as carbon, lipids, proteins and plant pigments. Out of these cellular components, the pigment analysis is most widely accepted. BGA has chlorophyll ‘a’ as the major light harvesting pigment along with carotenoids and phycobilins as accessory pigments. Measurement of chlorophyll ‘a’ at different stages of growth is often used as a growth parameter. Hence, another criterion undertaken for evaluation of efficient BGA in the present investigation was estimation of chlorophyll ‘a’ content. The result of the estimation showed varied amount of chlorophyll ‘a’ among the species from 0.016 to 0.50 mg/ml. *Anabaena torulosa* showed the highest amount of chlorophyll ‘a’ content (0.50mg/ml) accompanied with the highest amount of N-content (2.96%) and higher amount of *in vitro* biomass production (0.147 mg 100⁻¹ml) followed by *N. commune* (0.43mg/ml chl ‘a’; 2.96% N-content and 0.134 mg 100⁻¹ml
biomass). Similarly, *Anabaena felifissima* and *Aulosira felifissima* shares same higher amount (0.39 mg/ml) of chlorophyll ‘a’ having relation with higher amount (2.87% and 2.78%) of N-content and biomass production (0.142 and 0.105 mg 100^{-1}ml). These findings further justified the selection of this parameter as a screening criterion and from this, 10 cultures were selected for mass multiplication.

**5.3 PRODUCTION OF BIOFERTILIZER AS COMPOSITE INOCULUM**

A total of 10 cultures that drawn attention in terms of *in vitro* biomass production, N content and chlorophyll ‘a’ content were selected for mass multiplication *vis-à-vis* biofertilizer production.

In the present investigation, emphasis was given to develop a composite inoculum comprises with native potent species which might be used as algal biofertilizer. This is because a single paddy field harbours a number of different nitrogen fixing species like *Anabaena, Aulosira, Aphanothece, Calothrix, Cylindrospermum, Gloeotrichia, Nostoc, Plectonema, Scytonema* and *Tolypothrix* (Okuda and Yamaguchi 1956; Singh 1978; Santra 1993), those act in a composite manner. Moreover, Kannaiyan (1978) and Nayak et al. (1996) reported that inoculation with composite cultures is more effective than single culture inoculation. Selection of native species for composite inoculum is another important fact. This is because, most of the present study areas are found acidic (3.3 to 6.8) in nature and earlier workers (Okuda and Yamaguchi 1956; Singh 1984a; Roger and Reynaud 1977) reported the growth of BGA flourished in the pH ranges from 6.5 to 7.5. It is also reported that the Cyanobacteria in rice fields are subjected to stresses like acidity and salinity that affect their growth and function. Sardeshpandey and Goyal (1981) worked out that native strains of Cyanobacteria adapt better under acid soils than the introduced culture. Gopalaswamy (2001) also reported that the native strains are found to be performing better and are less prone to
inhibition against stress factors. He also focused that it is due to the ability of native strains those have gained momentum over the years to such abiotic stresses. Furthermore, the periodicity of BGA in rice field is also taken into account in the development of composite inoculum. This is because the nitrogen-fixing forms in rice fields of different species show succession throughout the cultivation cycle. To ensure the establishment of algae in the given habitat and in the different phases of cultivation cycle, the present composite inoculum was developed with five different species (Anabaena torulosa, Aulosira fertilissima, Calothrix marchica, Cylindrospermum majus and Nostoc commune). There is report that the growth and establishment of algae in a given habitat are greatly influenced by physical and chemical factors, which have been well illustrated by Roger and Kulasooriya (1980). There are many illustrated reports available for the occurrence of different species and genus in different phases of cultivation cycle. Roger and Kulasooriya (1980) reported that Anabaena and Nostoc can grow well under high light intensities. Singh (1976) observed the same phenomenon for Aulosira; although low light intensities are generally preferred by certain species like Cylindrospermum (Traore et al. 1978). Kannaiyan (1990) also observed the same condition for Gloeotrichia and Rivularia. This might be in support of present findings that composite efficient cultures differ in terms of algal genera and species that were selected for mass multiplication and inoculation in rice field of Morigaon district of Assam. This has been also relevant to the fact that despite of inoculation of composite culture of BGA, the population of Calothrix was drastically eliminated from the experimental plot at later stage. It might be due to the other factors like environmental changes and agronomic practices. The earlier report of Kannaiyan (1985c, 1990) also support the possibility of failure of establishment of Calothrix. Kannaiyan (1979) stated that algal populations appear to be highly susceptible to crop growth and environmental changes and agronomic and management practices. In the present study
also observed the establishment of *Anabaena*, *Aulosira*, *Cylindrospermum* and *Nostoc* in the rice field other than *Calothrix*.

In the present investigation, a portion of the mass cultured composite BGA was used for immobilization using paper bits. This has been done for improvement of quality of inoculum and the process of inoculation. Kannaiyan (1994) and Samal and Kannaiyan (1994, 1995) showed the significant effect of inoculation of immobilized Cyanobacteria in the transplanted rice. Uma and Kannaiyan (1995) also reported that the inoculation of immobilized Cyanobacteria improved the total carbohydrate, protein, amino nitrogen and chlorophyll content of the rice seedlings significantly. Although extensively used soil based composite inoculum gives very good response, sometimes its effect is drastically reduced due to varied reasons. It has also been observed that many a times soil based inoculum looses its purity because soil harbours other undesirable algae which upon inoculation may mask the effect of desired species and comes as contaminant resulting poor inoculation effect in rice field. Therefore, the best alternate option of improving the quality of inoculum is immobilization of BGA cultures. It has also been suggested the use of other substrates like sugarcane waste, coir waste, paper waste, hollow fibres, rice bran etc. (Aruna and Kannaiyan 1998; Suresh Babu and Kannaiyan 1998; Hall *et al.* 1998; Malliga and Subramanian 2001; Kumar 2003) for immobilization of Cyanobacteria. Kannaiyan (1996b) demonstrated the production of Cyanobacterial inoculants by sugarcane waste and paper waste for solid matrices for immobilization of Cyanobacteria in combination with rice husk and soil for improving the quality of Cyanobacterial biofertilizers. Uma and Kannaiyan (1996a) stated that PUF (Polyurethane foam) immobilized Cyanobacterial cultures recorded higher growth, nitrogenase activity, ammonia excretion and heterocysts frequency than free living cultures. Kannaiyan *et al.* (1998, 2000) reported that BGA cultures immobilized in PUF (Polyurethane
foam) and PVF (Polyvinyl foam) increase the quality and viability of Cyanobacteria and could survive for a period of 2 to 3 years. Apart from benefits, immobilized Cyanobacteria in different matrix give added advantages like prolonged survival, maintenance of pure culture, concentrated products, decrease in inoculum load etc. than conventional soil based inoculum. Above all, it is indeed less bulky and can be transported with ease. Thus, for the present production of biofertilizer, Cyanobacterial inoculum was prepared as immobilized form using ordinary filter paper. In the present investigation, preference was given to ordinary filter paper than any kind of organic waste to serve as carrier material for immobilized inoculum. This is in conformity with the report of Malliga et al. (1996) where it is found that Cyanobacteria may not degrade lignocellulosic compounds present in the all types of organic waste and in some cases the phenolic compounds from the waste may bring about adverse effect on the organisms. The foam products also do not get preference for inoculum preparation due to their non-biodegradability to the environment. Moreover, the viability, growth and biomass production of the immobilized paper bits was found very much encouraging after application in natural condition. Even upon inoculation, paper cuts after 7 months and 15 months showed good re-growth and biomass production, which showed the success of immobilization technique. Malliga and Subramanian (2001) suggested to select carrier material for immobilization of Cyanobacteria, which have higher absorptive capacity, good buffering capacity, non toxic, availability in adequate amounts and are helpful in increasing self life of inoculant, easy to sterilize and provide good adhesion. In the present investigation, ordinary filter papers fulfill the above requirements, which focus the success of immobilization technique.
5.4. EFFECT OF ALGALIZATION ON RICE

An experiment was conducted to study the effect of algalization with composite inoculum on yield and yield attributing characters in rice variety 'Jaimoti' grown as early Ahu. In this experiment, N supplementation by algalization was also assessed with inoculation of composite cultures of Cyanobacteria along with different doses of nitrogen. The results were recorded in terms of plant height, number of effective tillers, number of panicle per plant, grain yield and straw yield. The results showed promising trend in terms of rice yield and yield attributing parameters. In most of the case, algalization along with ½ of the recommended dose of nitrogen exhibited at par or even better as compared to treatment that received recommended dose of nitrogen alone. The highest benefits in grain yield and straw yield were recorded in the treatment combination of BGA inoculation along with ½ of the recommended N dose. The above findings are in corroboration with a large number of field trials conducted by State Department of Agriculture, All India Coordinated Project on Algae, Department of Biotechnology (AICPA 1981) in different parts of the country assessing the effect of algalization on rice yield. Experiments conducted in many farmers' field in India revealed that increase in rice yield with BGA was about 0.2t/ha (Srinivasan and Ponnaya 1978). The positive effect of algalization of different parameters in rice was recorded irrespective of varieties (Relwani 1967). Venkataraman (1972, 1980), Saha and Mandal (1980) and Santra (1991) conducted several demonstrations with different rice varieties in different locations and recorded the same effect from algalization. They also reported that BGA inoculation was equivalent to application of nitrogen (20–30 kg/ha). This has been authenticated by Managave et al. (1993) who conducted an experiment to study the response of paddy varieties to BGA inoculation.
It has been estimated that in absence of chemical N fertilizer, BGA inoculation enhances the yield of rice from a minimum of 4% to a maximum of 32.8% and application of BGA with recommended dose of N fertilizer increases rice yield only about 8.8%. In the report of AICPA (1981), it was found that the Cyanobacterial inoculation gives a net saving of 25-30 kg N ha\(^{-1}\) in addition to 10-15% increase in rice yield on an average. Singh (1981) reported that the beneficial effect was not obtained when nitrogen was applied beyond 20 kg.

In the present experimental results on yield also revealed considerable enhancement under algalization treatment alone as compared to non algalized treatment. The highest per cent increase over control was recorded in the treatment combination of BGA inoculation along with \(\frac{1}{2}\) of the recommended dose of nitrogen (189%). However, at recommended dose (40 kg N/ha), inoculation effect although showed increasing (153.5%) trend than uninoculated control (133.5%) with the recommended dose of nitrogen; the value was far less than the treatment that received \(\frac{1}{2}\) of nitrogen with BGA (189%). Similar result of algalization on grain yield with \(\frac{1}{2}\) of the recommended dose of nitrogen and the inhibitory effect with recommended dose with chemical N fertilizer was reported by many earlier workers some of which are cited below. During 1978 and 1979, field experiments of CRRI, Cuttak indicated that mixed inocula of *Aulosira, Aphanothece* and *Gloeotrichia* increased grain yield by 10, 17, 32 and 35 per cent respectively. Bagal and Patil (1984) reported that BGA application could reduce the fertilizer nitrogen dose to the extent of 16%. Roger (1991) after 260 field experiments concluded that the BGA inoculation might enhance the average grain yield by 3q/ha. Singh *et al.* (1992) noted a maximum increase in grain yield up to 6.25 q/ha in different varieties of paddy by algal inoculation in ten districts of U.P. Of the 2774 farm trials conducted in 32 districts covering 9 agroclimatic zones of U.P. in different rice fields at recommended dose of N, the increase in yield with application of BGA biofertilizer varied
from 1.10 to 5.33 q ha\(^{-1}\) (Tripathi et al. 2001). These are in conformity to present finding that application of BGA enhances the rice yield and could reduce the chemical fertilizer dose.

From the present investigation, it may be stated that yield attributing parameters are also benefited by the effect of algalization. Though inoculation treatment did not show a definite pattern in per cent increase in effective tillers, however significantly enhanced number of panicles per plant. In the panicle number, the highest increase was observed in the treatment where nitrogen was added at \(\frac{1}{2}\) of the recommended dose along with BGA. Several reports which state that algalization increased the plant height (Singh 1961, 1984); leaf length (Watanabe et al.); number of tillers (Singh 1961, 1984); number of ears and spikelets per panicle (Jalapathi Rao et al. 1977) are available. Further the reports of Roger and Kulasooriya (1980) and Singh (1984, 1985) stated that algalization also increased yield attributing characters such plant size, number of tillers, ears, spikelets and filled grain per panicle, which are conformity with the present study. It may be concluded from the present experimental findings that there is potential benefit on yield and yield attributing parameters of algalization when the fertilizer nitrogen dose is reduced to half.

Population succession of Blue Green Algal species holds a key role in the effect of algalization process. This is because BGA are living biosystem and once they establish, their biological activity retain as a continuous process. In the present investigation also, a study was conducted to know the population succession. It has been observed that introduced BGA species could survive in the experimental plot where these species were not available earlier. Among five inoculated species, four species (Anabaena torulosa, Aulosira fertilissima, Cylindrospermum majus, and Nostoc commune) were able to colonize in the cropping system and the habitat. On the basis of algal inoculation for three or four consecutive cropping systems, Kannaiyan (1990) reported that the inoculated BGA establish well and the effect
towards the subsequent rice crop. It was also stated that the beneficial effect could be seen in subsequent years without any further inoculation unless some unfavourable soil ecological conditions operate. The elimination of *Calothrix* might be due to some such type of ecological conditions prevail in the plot as it received same kind of agronomic and management practices.

The results showed that algalization affect not only enhanced grain yield and other parameters, but also reflected on the residual nutrient build-up (especially nitrogen and organic carbon) when compared with the initial status. The organic carbon was increased from 0.72% to 1.10% and nitrogen increased from 410 kg/ha to 523 kg/ha in the experimental plot, which showed beneficial effect of algalization. The results of several field trials conducted in Tamil Nadu (Kannaiyan 1979) have shown the positive residual effect of algal inoculation on rice yield is in conformity to the present findings. Roger and Kulasooriya (1980) explained the methods of availability of the nitrogen to the rice crop. They stated that release of nutrients through microbial decomposition after the death of the algae appears to be the principal means by which N is made available to the rice crop. Nitrogen fixed by the algae is released either through exudation or through microbial decomposition after the cells die. Grazers through their digestive tracts also make algal nitrogen available to rice. Kannaiyan (1990) has also reported that in paddy fields the death of algal biomass is most frequently associated with soil desiccation at the end of the cultivation cycle and algal growth has frequently resulted in a gradual buildup of soil fertility. Reports are available about the addition of organic matter to the soil (Singh and Bisoyi 1989; Das *et al.* 1991), which further confirms the increase of fertility status of soil in study area.

Certain $N_2$ fixing as well as non $N_2$ fixing algae were known to immobilize during the period of unflavourable climatic condition for algal growth and development. During this
process of temporary immobilization (perennation period), BGA conserves the nitrogen on their cell system and prevent nitrogen loss from rice fields. These results showed conformity with the present findings of increase in OC and N.

Similarly, Kannaiyan (1993) reported that $N_2$ fixing algae also conserve the phosphorus in soil. He also stated that the organic acids excreted by $N_2$ fixing algae also solubilize the unavailable phosphorus and utilize for its growth and $N_2$ fixation and later phosphorus is released into the soil solution during decomposition process of the algae. Algal flora also stores the phosphorus in the form of polyphosphate granules in their cell system and it reaches the soil during decomposition. The result of present investigation showed P availability decreased from initial status from 10 kg/ha to 9.8 kg/ha. It can be inferred that the most of the soils of Morigaon district has trace to less amount (below 2.1 to 44.9 kg/ha) of P. Even then, in the experimental plot did not show much decrease (only 0.20 kg/ha) in P availability. It is more or less similar in amount compared to the initial status may be due to the conservation by BGA.

From the above discussion, it becomes evident that Blue Green Algae are ideal biological system for better nitrogen fixation and conservation on rice soil of Morigaon district that produce Boro paddy and provide conducive environment. This potential group of nitrogen fixing algae may be better exploited for harnessing atmospheric nitrogen so as to increase the productivity of rice. The farmers could also gain economic benefit with the use of low cost, ecofriendly and easily producible algal biofertilizer.