SUMMARY AND CONCLUSIONS

Studies pertaining to inoculum production of blue-green algae (cyanobacteria), its growth and \( \text{N}_2 \)-fixation during cultivation cycle and use for rice crop were attempted in field incubation experiments.

Inoculum production

Growth and \( \text{N}_2 \)-fixation due to split application of P were superior to basal application and good response at 40 kg P\(_2\)O\(_5\)/ha was observed harvesting about two times of basal application at 3 split of P, using the mixture inocula of Aulosira sp., Aphanothece sp. and Gloeotrichia sp. Growth and \( \text{N}_2 \)-fixing ability among the locally dominant species of Aulosira sp., Aphanothece sp. and Gloeotrichia sp. were assessed with the amendment of P (20, 40 and 60 kg P\(_2\)O\(_5\)/ha). From the data Gloeotrichia sp. proved efficient in growth but had poor nitrogen-fixing ability, whereas Aulosira sp. was found to be a good \( \text{N}_2 \)-fixer. Addition of more than 40 kg P\(_2\)O\(_5\)/ha indicated no beneficial effect on the growth and \( \text{N}_2 \)-fixation.
of Aulosira sp. Attempts to compare the growth and N$_2$-fixation of the soil based inoculum grown locally and outside state revealed that inoculum brought from longer distance of about 1500 km could not establish in the introduced area which was attributed to the presence of indigenous BGA. Amendments of P application showed abundant growth of indigenous BGA of Wollea sp. which extrapolated an amount of 2 kg N/ha/30 days.

Since nitrogenous and potassium fertilizers are indispensable for rice cultivation, the effect of N and K was evaluated on BGA production. The information from experiments indicated negative linear relationship between N application and BGA growth, whereas evidence of K effect on growth and N$_2$-fixation was not noticed.

Role of biotic factors influencing the growth and N$_2$-fixation was evaluated which revealed that carbofuran at 2.5 kg a.i./ha responded to produce about 2-3 times harvest of biomass and N$_2$-fixation which is ascribed as a suitable dose for algal multiplication. The growth of BGA with one of the predator snail (Idiopoma dissimilis) and different
insecticides used for rice at recommended dose was assessed periodically. Snail mortality ranged from 1 to 42 per cent and most effective was thimet. The relationship between snail mortality and BGA growth was observed where BGA growth increased with decrease in snail population.

Attempts were made to identify the role of climatic factors like water temperature, solar radiation, rainfall and sunshine hours on BGA production and N$_2$-fixation during the period of study from March, 1980 to June, 1981. In summer season (March to May), the harvest of BGA was 192 to 366 kg dry weight/ha, whereas 8 to 20 kg and 3 to 28 kg dry weight/ha were observed during winter (October to January) and monsoon months (June to August) respectively. The N accumulation during the period of study was 71.24 kg N/ha. Variation of BGA biomass contributed only 50.31 per cent as explained by the equation.

\[ Y = 18.88 \times X_1 + 19.21 \times X_2 + 68.78 \times X_3 + 0.14 \times X_4 - 1.11 \times X_5 - 531.81 \]

Where, \( X_1 = \) Maximum water temperature of the day (°C)
\( X_2 = \) Minimum water temperature of the day (°C)
\( X_3 = \) Total solar radiation of the month (K Cal/m$^2$/month)
Among the climatic factors, solar radiation contributed significantly for the algal production. Similar trend of data was observed in N\textsubscript{2}-fixation also.

Blue-green algae growth in rice fields

A close examination of results on inoculum growth in presence of rice obtained during the dry season, 1980, wet season, 1980 and dry season, 1981 revealed significant and positive effect of inoculation of Aulosira sp. harvesting 54-338 kg (dry weight/ha) using 6 kg/ha inoculum. The average N yield in various treatments gave about 3 times higher N harvest. Studies were conducted to assess the growth and N\textsubscript{2}-fixation potentiality of fresh and dry BGA inoculum which showed the superiority of fresh form of inoculum over dry form. The mean biomass produced was 128, 233 and 162 kg (dry weight)/ha by fresh form of inoculum, whereas with dry form of inoculum it was 71, 204 and 124 kg (dry weight)/ha at 30, 50 and 70 days after inoculation respectively. Higher N yield (2.2 times) was obtained by fresh inoculum than dry form.
Effect of N additions for rice was studied. The growth and $N_2$-fixation of inoculated and indigenous BGA gradually decreased from lower to higher doses of Ammonium and urea N.

The role of P application on the appearance, growth and $N_2$-fixation of indigenous BGA was investigated during the crop growth without use of N fertilizer. The dominance of $N_2$-fixing BGA Aphanothece sp. and Gloeotrichia sp. was marked. The mean biomass produced was 148, 162 and 204 kg/ha at 20, 40 and 60 P$_2$O$_5$/ha against 26 kg in control showing highly responsive influence of P. Interaction between levels and methods of P application was not observed.

Variation of algal biomass at different stages of rice cultivation cycle was observed. The results revealed the occurrence of maximum biomass around panicle initiation stage of rice during wet and dry seasons. Data on doubling period showed less time consumption by indigenous BGA which was less or at par with the inoculated BGA between transplanting and maximum tillering stage. The growth of BGA declined after panicle initiation stage showing less biomass at heading stage.
Algalization

The in situ grown inoculated BGA *Aulosira* sp. was utilized for possible effect on rice improvement.

The effect of BGA inoculation on growth, yield attributes of rice and soil properties was studied. The dry matter of rice increased by 2-28 per cent, but no significant result was obtained in panicle number production in unit area by BGA inoculation. The grain yield increased by 10-21 per cent due to algal inoculation without addition of any nitrogenous fertilizer. The straw yield marked increase of only 7-10 per cent due to algalization. The N-uptake by rice varied from 35 to 51 kg N/ha in untreated plots. Due to algal inoculation significant increase of 8-37 per cent N-uptake was observed. The influence of algal inoculation on soil properties was not significant in the first and second seasons, but responded in the third rice cropping season. The soil organic carbon significantly influenced by the algal inoculation which registered 2-11 per cent increase. A gradual increase in rice yield was noticed from second cropping season to succeeding season.
Studies on the effect of fresh and dry form of algal inoculum on rice yield showed the superiority of fresh form of inoculum over the dry form.

The effect of BGA incorporation to the soil was evaluated against BGA unincorporated in terms of response in rice crop growth, yield and change in soil nitrogen and organic carbon content. The grain yield registered an increase of 13-15 per cent due to BGA incorporation than the unincorporated ones and soil nitrogen and organic carbon also showed appreciable increase.
CONCLUSIONS

The experimental evidences presented suggest beneficial effects of BGA could be achieved where nitrogen alone is limiting factor in rice cultivation.

i. Split P fertilization is superior to basal application for algal growth.

ii. Local strains having high establishing capacity and N₂-fixing ability yield rich harvest over transported BGA.

iii. Strengthening the indigenous N₂-fixing flora gives more biomass and N yield.

iv. Control of BGA predators through suitable insecticide results in increased biomass and N₂-fixation.

v. Exploitation of natural resources of climatic conditions contributes substantial nitrogen where high solar radiation during summer is considered as important for good BGA growth.
vi. Fresh inoculum is superior to dry inoculum.

vii. Implementation of algalization techniques like in situ grown and incorporated BGA yield rich rice harvest.

viii. Extrapolation of algalization by indigenous BGA increases rice yield.

The proper understanding of the enigmatic growth of BGA in rice field ecosystem is essential for minimising the currently known nitrogen scarcity for effective changes in agricultural utilization by maximising its accrued use.