Journal of the Andaman Science Association Vol. 18(2):175-178 (2013)
ISSN 0970-4183, Printed in India

www.asapb.org

COASTLINE TOLERABLE SPECIES OF HETEROCYSTUS FORMS OF CYANOPROKARYOTES

Sarika Kesarwani and Lal Ji Singh*
Department of Botany, University of Allahabad, Allahabad - 211002 (U.P.) India
* *Botanical Survey of India, ANRC, Port Blair - 744102 Andaman & Nicobar Islands, India.*
**Corresponding E-mail: kesarwani.sarika1@gmail.com, laljisingh1970@redffmail.com*

ABSTRACT

Agricultural sustainability has the highest priority with crop improvement at global level, although it is a serious problem of agriculture in the Coastal region due to the presence of saline soil. So it is necessary to determine the salinity tolerable species for the better production of agriculture. In this context, the present work deals with the salinity tolerance test of Blue green algae (BGA) as they have been used as a biofertilizers. Seven strains of heterocystus forms of Rivulariaceae have been selected and examined viz. *Calothrixstagnalis, Calothrixthermalis*, *Calothrixelinkinii*, *Calothrixjavanica, Dichothrixbaeuriana, Gloeotrichiaraciborskii* and *Gloeotrichianatans*. The result indicated that the most tolerant species are *Calothrixthermalis* and *Calothrixelinkinii*. Therefore, they may be effectively used as biofertilizer and soil conditioners for the coastal areas. It benefits crop plants through excreting part of the biologically fixed nitrogen, secreting growth promoting substances and different types of metabolized substances that helps to keep in the soil with all the essential nutrients for the sustainability of crop and its improvement.

Key words: Coastal region, Saline soil, Blue - green algae, Biofertilizer.

INTRODUCTION

Salinity is wide spread around the world and is a serious problem in nearly half of the world. In India, about 7 million hectares of arable land is adversely affected by salt, leading to an loss of land area for effective crop production. Salt affected soils are normally grouped as saline, saline alkali and alkaline soils. In order to keep the marginal saline alkali lands in production and to reclaim previously non-arable areas, application of organic inputs including blue-green algae (BGA) may prove a better alternative (Singh, 1950). Itsstrain developed into a viable technology by various workers (Kaushik, 1990). The addition of autochthonous cyanobacterial strains to such system results in sustaining organic carbon and nitrogen, reduction in pH, improvement in tilth, increase in exchangeable calcium and water holding capacity and immobilization of Na^+ by converting sodium clay into calcium type. In general microbes live within the limits of pH 4 to 9 and growth optima near neutrality. Microbes having growth optima above pH 9 and requiring salt for growth have been termed alkalopholic/ halophilic and those have growth optima below pH 9 but can survive extended exposure above it and can tolerate high salt concentration have been termed halo tolerant/ alkali tolerant.

Sodium is predominant soluble cation in most saline soils and water. There are many reports on the response of cyanobacteria to NaCl (Tel-Or, 1980; Apte and Thomas, 1983; Thomas and Apte, 1984; Kaushik, 1990; Saxena and Kaushik, 1992 and Kaushik and Nagar, 1993). Cyanobacteria evolved nearly 3 billion years ago as group of first oxygen evolving organisms on the earth. These are capable of fixing atmospheric nitrogen and effectively employed in agriculture as biofertilizer and soil conditioners and are known to be primary colonizers of inhospitable ecosystem. They as a group are characteristically alkali tolerant or alkalophilic. In salt affected soils, after the first shower of monsoon, these organisms are the first to appear. It generated the idea that cyanobacteria /blue green algae (BGA) may have potential to scavenge toxic cation sodium (Na^+) from the soil complex and improve soil properties. Singh (1961) recorded the early appearance of *Microcoleus*, *Porphyrosiphon*and *Scytonema*species on the loose as well as compact salt afflorescence of sodium on salty soils and these were followed by *Champtylonema*, *Cylindrospermum*and *Nostoc*species. Cyanobacteria react to salt stress either through osmotic adjustments, sequestering the inorganic ions, or secretion of excess of polysaccharides (Saxena and Kaushik, 1992). Indications of increased nitrogen demand and accumulation of K^+ by cyanobacteria under salt stress are also available and sodium is primarily reduced in the environment (Jha *et al*., 1987; Jha and Kaushik, 1988).

MATERIAL AND METHOD

Seven different species of diazotrophic cyanobacteria belonging to genus *Calothrix*, *Dichothrix*and *Gloeotrichia*viz. *Calothrixstagnalis, Calothrixthermalis, Calothrixelenkinii, Calothrixjavanica, Dichothrix baeuriana, Gloeotrichiaraciborskii* and *Gloeotrichianatans*were used as the experimental material. Growth experiments were done in 150 ml cotton stoppered hard glass flasks. Medium used for the experiment is BG-11 medium (Stanier *et. al*., 1971) and stock solution of NaCl was prepared by adding 58.5 gm of NaCl in 1 liter distilled water to prepare 1M concentration of solution. Various concentrations of NaCl were made in the flasks are:

0.05M conc.: 0.290gm NaCl + 100ml BG-11medium +5ml culture

0.10M conc.: 0.585gm NaCl + 100ml BG-11medium +5ml culture

0.15M conc.: 0.880gm NaCl + 100ml BG-11medium +5ml culture

0.20M conc.: 1.170gm NaCl + 100ml BG-11medium +5ml culture

0.25M conc.: 1.460gm NaCl + 100ml BG-11medium + 5ml culture

0.30M conc.: 1.755gm NaCl + 100ml BG-11medium + 5ml culture

After preparing required concentrations all the flasks were sterilized properly. Equal amount of homogenized culture suspension from exponential growth phase of each organism was inoculated into the experimental flasks and incubated for 15 days under constant aeration at 4000 lux and 28+2° C. Growth was expressed on terms of chlorophyll percentage. Chlorophyll was measured after (Mackinney, 1941).

Procedure for measurement of Chlorophyll: 10 ml suspension was taken after shaking, culture was centrifuged for 5 min supernatant was decanted and 10 ml of 90% methanol was added to algal pellet and shakes well. After shaking it was kept in 60ºC water bath for 5 minutes and the temperature was maintained to the level of room temperature. Finally, the whole content was centrifuged and optical density (O.D.) of supernatant was taken at 665 nm.

Calculation: Chl. (ìg / ml) = 2.5 x 10 $^{-2}$x OD 650 + 0.0 4 x 10^{-2}x OD 665

Chl. = 13.42 x OD 665

RESULTS AND DISCUSSION

The present study shows the comparative potential of 7-coastal line tolerable species (Table-1) and revealed that the most tolerant species is *Calothrixthermalis* which can tolerate up to 0.30M concentration of NaCl and is better grown in 0.05M concentrated solution of NaCl as compared to controlled condition. Both the species of *Gloeotrichia*viz, *Gloeotrichiaraciborskii* and *Gloeotrichianatans*were relatively more susceptible to high concentration of NaCl; firstly they show increase in chlorophyll amount at 0.05M concentration of NaCl but at 0.30M concentration chlorophyll a content of these organism decreased to zero. Whereas *Dichothrixbaeuriana*was intermediate to the others. The increasing order of their salt tolerance at 0.25M concentration of NaCl are:

Gloeotrichianatans	(0.00 g/ml)
Gloeotrichiaraciborskii	(0.02 g/ml)
Dichothrixbaeuriana	(0.84 g/ml)
Calothrixjavanica	(2.18 g/ml)
Calothrixstagnalis	(2.48 g/ml)
Calothrixelenkinii	(5.05 g/ml)
Calothrixthermalis	(7.68 g/ml)

Thus, the authors concluded that when selected strains of BGA are applied in saline or coastline soil, it reduces soil pH, electrical conductivity and exchangeable sodium. They secrete extracellular polysaccharides in excess in response to salts and liberate organic acids and enzyme alkali phosphatase. They also taken-up some of the salts for their own growth and thus there is temporary immobilization of cation.

Table 1: Effect of NaCl on seven strains of family Rivulariaceae

S. N.	Strains	Chlorophyll content (µg/ml)						
		control	0.05M	0.1M	0.15M	0.2M	0.25M	0.3M
1.	*Calothrix stagnalis*	13.48	13.98	6.48	3.52	2.59	2.48	1.32
2.	*Calothrix thermalis*	11.15	19.27	18.66	11.01	8.45	7.68	5.52
3.	*Calothrix elenkinii*	20.97	16.25	9.59	6.17	5.20	5.05	3.91
4.	*Calothrix javanica*	18.43	16.45	10.36	2.75	2.67	2.18	1.36
5.	*Dichothrix baeuriana*	12.88	6.33	3.40	1.11	0.99	0.84	0.73
6.	*Gloeotrichia raciborskii*	6.22	6.17	5.01	0.69	0.26	0.02	0.00
7.	*Gloeotrichia natans*	11.31	16.30	10.76	0.67	0.49	0.00	0.00

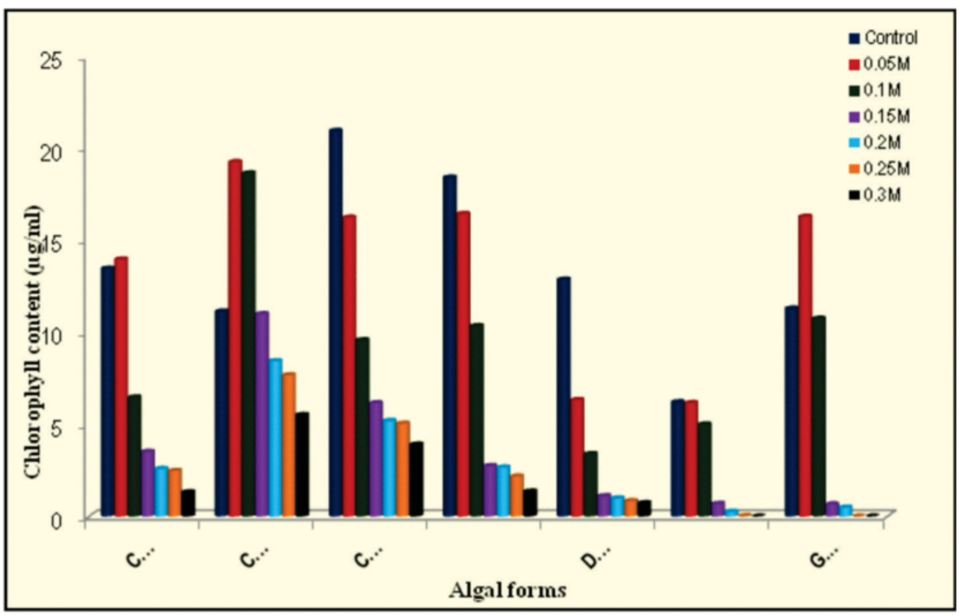

Fig.1: Effect of NaCl on 7 strains of family Rivulariaceae

ACKNOWLEDGEMENT

The authors are thankful to Prof. G. L. Tiwariand Prof D. R. Misra, Department of Botany, University of Allahabad for his valuable suggestions and guidance. One of the authors (LJS) is grateful toDr. P. Singh, Director and Dr. D. K. Singh, Scientist 'F', BSI, Kolkata for their facilities and constant support.

REFERENCES

Apte, S.K. & Thomas, J. (1983). Sodium transport in filamentous nitrogen fixing cyanobacteria.*J.Biosci*. 5: 225-234.

Jha, M.N. & Kaushik, B.D. (1988). Response of *Westiellopsisprolifica* and *Anabaena* sp. to salt stress II.Uptake of Na^+ in the presence of K^+ as chloride, nitrate and phosphate.*Curr.Sci*. 57: 667-668.

Jha, M.N., Venkataraman, G.S. & Kaushik, B.D. (1987). Response of *Westiellopsisprolifica* and *Anabaena* sp. to salt stress.*Mircen.J*. **3**: 307-317.

Kaushik, B.D. (1990). Cyanobacteria- some aspects related to their role as ameliorating agent of salt affected soils. *In*: Perspectives in Phycology. (ed.) VN Raja Rao, p. 404, Today and Tomorrow Publ., New Delhi.

Kaushik, B.D. & Nagar, A.P. (1993). Sodium uptake by halotolerent*Westiellopsisprolifica* in presence of K, Ca, Mg, Fe and Li.*IndianJ. Microbiol*.33: 93-96.

Mackinney, G. (1941). Absorption of light by chlorophyll solution, *J. Biol. Chem*. 140: 315-322.

Saxena, S. & Kaushik, B.D. (1992). Polysaccharides (biopolymers) from halotorent cyanobacteria. *Indian J. Exptl Biol*. 30: 433-434.

Singh, R.N. (1950). Reclamation of usar lands in India through blue-green algae. *Nature*, 765: 325-326.

Singh, R.N. (1961). Role of blue-green algae in nitrogen economy of Indian Agriculture.pp 175, Pub.Indian Council of Agricultural Research, New Delhi.

Stanier, R.Y. Kunisawa, R.M., & Cohen Bazire, G. (1971). Purification and properties of unicellular blue-green algae (order Chroococcales), *Bacterial.Rev.* 35:171-205.

Tel-Or, E. (1980). Response of N_2- fixing cyanobacteria to salt. *Appl. and Environ. Microbiol.*, 10: 689-693.

Thomas, J. & Apte, S.K. (1984). Sodium requirement and metabolism in nitrogen fixing cyanobacteria.*J. Biosci*. 6: 771-794.