http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 6 (20): 1751-1752, 2003
ISSN 1028-8880

Role of Cyanobacteria in Improving Fertility of Saline Soil

M.A. Aziz and [1]M.A. Hashem
Bangladesh Rice Research Institute, Gazipur, Bangladesh
[1]Soil Science Department, Bangladesh Agricultural University, Mymensingh, Bangladesh

Abstract: An experiment was carried out in the saline soil of Satkhira during the aman season of 2000 in order to test the effectiveness of the cyanobacterial inoculum on soil fertility. The modern rice variety BRRIdhan 31 was used as the test crop. There were six treatments for the experiment viz. T_1 (control), T_2 (Recommended Fertilizer Dose), T_3 (R-FD-20%N), T_4 (RFD-2O%N+Cyanobacteria), T_5 (RFD-40%N) and T_6 (RFD-40%N+Cyanobacteria). Eight cyanobacterial strains were isolated, identified and brought under pure unicyanobacterial cultures from the selected location. Cyanobacterial inoculum was applied @ 20 kg ha^{-1} in two equal splits-7 and 30 days after transplanting. Results of field trials indicated that cyanobacterial inoculum could supplement up to 20% nitrogen for rice cultivation in saline soils. Inoculation of the cyanobacterial inoculum in the saline soil resulted in an increase in organic matter, total N and available P status of the soil. Among the parameters, increase in organic matter and total N were statistically significant. Results of the experiments clearly indicated that cyanobacterial inoculum might be used effectively for improving soil fertility of saline soil.

Key words: Cyanobacteria, saline soil, soil fertility

INTRODUCTION

Soil salinity appears to be a major problem in Bangladesh agriculture. Agricultural land use In saline areas is very poor, which is much lower than the country's average cropping intensity (Banu *et al*., 1993). Rice production in the country has been seriously hampered by the high soil salinity and this problem is becoming more serious every year (Hashem *et al*., 1995). Improving the fertility of the saline soil is an utmost necessary from the agriculture point of view. The saline soil of Bangladesh have been managing by the farmers themselves using the impact of monsoon rains during the salinity and allowing easy cultivation of transplanted aman rice. Soils which contain sufficient neutral soluble salts in the root zone to adversely affect crop growth and production are termed saline soils (Hashem, 2001). Soluble salts are predominantly the chlorides and sulphates of sodium, calcium and magnesium. Sodium chloride is the dominant salt. The saturated paste pH of saline soil is less than 8.5 and the electrical conductivity of the saturation extract is generally more than 4 dS m^{-1} at 25°C. Saline soils are not suitable for crop production although they have high agriculture potential (Hashem, 2001). The present study has been planned with the following objectives: 1.To identify the Cyanobacterial strains occurring in saline soils.2. To determine the role of cyanobacteria in improving fertility of saline soil.

There are reports that some cyanobacteria can grow successfully on saline soil where most plants with the exception of halophytes fail to grow. The fertility of saline soil can be improved by using cyanobacteria. Soil based cyanobacterial inoculum that are prepared from saline soils and that are adopted to areas ecological problem may effectively be used in N economy and improved fertility of these soils.

MATERIALS AND METHODS

The experiment was conducted at Shymnagar, Satkhira during the T. Aman season of 2000. The experimental plot belongs to non-calcareous Grey Floodplain. The soil was leam with pH 7.9, organic matter 1.93%, total nitrogen 0.18%, available P 18.3 ppm and available S 14.5 ppm. Soil texture, pH, Organic matter, total nitrogen, available P and S were determined following standard methods (Black, 1965; Jackson, 19621; Page *et al*., 1982; Olsen *et al*., 1954). The experiment consisted of six treatments comprising T_1 = Control, T_2 = Recommended Fertilizer Dose (RFD), T_3 = RFD-20%N, T_4 = RFD-20%N+Cyanobacteria, T_5 = RFD-40% N and T_6 = RFD-40%N+Cyanobacteria. The experiment was laid out in randomized complete block design (RCBD) with four replications having unit plot size of 5x4 m^2 . The fertilizer rates used were 65 kg N ha^{-1} from urea, 8 Kg P ha^{-1} from triple superphosphate, 30 Kg K ha^{-1} from muriate of potash and 5 kg S ha-from gypsum. Urea was applied in three equal splits-first during final land preparation and the remaining in two equal splits at maximum tillering and panicle initiation stages of crop growth. Cyanobacterial inoculum was applied @ 20 kg ha^{-1} in two split-7 and 30 days after transplanting. The rice variety used was BRRIdhan 31 as test crop. Thirty five days old seedling were transplanted on 4 Aug. 2000,

maintaining a spacing 20x15 cm^2, three seedling being transplanted $hill^{-1}$. Necessary intercultural operations were done as and when required during growth period of crop. The crop was harvested plot wise on 17 Dec. 2000. The yield components and yield were recorded. All the parameters under study were statistically analyzed by F-test to examine the treatment effects and the mean difference were adjudged by Dancan's multiple range test (DMRT) (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Organic matter: The organic matter content of the post harvest soils varied from 1.82 to 2.02%. The organic matter content of initial soil was 1.93%. It was observed that organic matter content tended to increase in the soils treated with T_4 (RFD-20% N+Cyanobacteria) and T_6 (RFD-40% N+Cyanobacteria). T_1 (control), T_2 (RFD), T_3 (RFD-20% N) and T_5 (R-FD-40% N) caused a decreasing effect of organic matter. All these 4 treatments did not contain cyanobacterial inoculum The highest Value of organic matter was found in T_6 (RFD-40% N+Cyanobacteria) which was statistically identical with T_4 (RFD20%N+Cyanobacteria). The lowest organic matter content was in T_2 (RFD) which was statistically identical with T_1 (control), T_3 (RFD-20% N) and T_5 (RFD-40% N). The increase in organic matter contents in treatments T_4 and T_6 (both the treatment contained cyanobacterial inoculum) clearly indicated that this increase was due to application of cyanobacteria.

Table 1: Effect of cyanobacterial inoculum on organic matter and total nitrogen contents of the post harvest experimental soils

Treatments	Organic matter	Total N (%)
T_1 = Control	1.83b	0.16ab
T_2 = RFD	1.82b	0.18ab
T_3 = RFD-20%N	1.82b	0.16ab
T_4 = RFD-20%N+Cyanobacteria	2.01a	0.21a
T_5 = RFD-40%N	1.83b	0.14b
T_6 = RFD-40%N+Cyanobacteria	2.02a	0.19ab

In a column, the figures having common letter(s) do not differ significantly at 5% level of significance

Total nitrogen: The application of different treatments caused a slight variation in the total N content of the post harvest soils compared to the initial soil. The initial status of total nitrogen was 0. 18%. The maximum total nitrogen in post harvest soil was in treatment T_4 which was statistically identical with T_1 (control), T_2 (RFD), T_3 (RFD-20% N) and T_6 (RFD-40% N+Cyanobacteria). The lowest value of 0. 14% was found in T_5 (RFD-40% N).

Banu *et al.* (1993) observed that *Nostoc* H.17, *Scytonema* H.26 and *Fischerella* H.39 fixed high amount of nitrogen under high saline conditions.

A good number of reports also support that cyanobacteria can fix a significant amount of atmospheric nitrogen eg. Roger and Kulasooriya (1980) described that the generally accepted amount of N fixed by cyanobacteria is on average 30-40 kg ha^{-1} $crop^{-1}$ (Table 1).

Table 2: Effect of cyanobacterial inoculum on available phosphorus and sulphur contents of the post harvest experimental soils

Treatments	Available P (ppm)	Available S (ppm)
T_1 = Control	17.4	14.0
T_2 = RFD	18.2	15.6
T_3 = RFD-20%N	18.3	15.4
T_4 = RFD-20%N+Cyanobacteria	19.0	15.8
T_5 = RFD-40%N	18.3	15.4
T_6 = RFD-40%N+Cyanobacteria	19.1	15.7

Available phosphorus: Available P content of post harvest soils was not significantly influenced by different treatments though treatments having cyanobacterial Inoculum showed higher amount of nitrogen than those having no inoculum. Available P content varied from 17.4 to 19.1 ppm. Available P content of initial soil was 18.3 ppm. The highest P content of 19.1 ppm was recorded in T_6 (RFD-40% N+Cyanobacteria). The lowest P content was noted in T_1(control) (Table 2).

Available sulphur: Soil available S was not significantly affected due to application of the cyanobacterial isolates. Nevertheless, plots treated with cyanobacterial inoculum had little higher S content than those having no inoculum The S content of post harvest soil ranged from 14.0 to 15.8 ppm. The maximum S content of post harvest soil was recorded in treatment T_4 (RFD20% N+Cyanobacteria) and the lowest was noted in the control.

REFERENCES

Banu, N.A., M.A. Hashem and M.R. Islam, 1993. Growth and nitrogen fixation of blue-green algae isolated from saline rice soils of Bangladesh. Bangladesh J. Soil Sci., 24: 63-72.

Black, C.A., 1965. Methods of Soil Analysis. Part I and II. Am. Soc. Agron. Inc. Pub., Madison, USA.

Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 2nd Ed. John willey and sons. New York, pp: 97.

Hashem, M.A., M.R. Islam and N. A. Banu, 1995. Nitrogen fixation and salinity reduction by blue-green algae. Bangladesh J. Agril. Sci., 22: 251-256.

Hashem, M.A., 2001, Role of blue-green algal inoculum for improving soil fertility and reclaiming salinity of soil. Research Report. BARC. Dhaka, Bangladesh, pp: 2.

Jackson, M.I., 1962. Soil Chemical Analysis. Constable and Co. Ltd. London.

Kulasooriya, S.A. Roger and I. Barraquioand Watanabe, 1980. Epiphytic nitrogen fixation on deep water rice. Soil Sci. Plant Nutr., 27: 19-27.

Oslen, S.R., C.V. Cole, F.S. Watanabe and L.A. Dean, 1954. Estimation of available phosphorus in soils by extraction with Sodium carbonate U.S. Dept. Agr. (Circ.) pp: 929.

Page, A.L., R. H. Miller and D.R. Keeney, 1982. Methods of Soil Analysis Part 2. 2nd Ed. Am. Soc. Agron. Increased. Madison. Wisconsin, USA.