African Journal of Biotechnology Vol. 11(61), pp. 12472-12474, 31 July, 2012
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB11.2149

Short Communication

Effect of blue-green algae on soil nitrogen

Yagya Prasad Paudel* and Shreeti Pradhan

Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.

Accepted 30 September, 2011

Nitrogen fixed by cyanobacteria is released either through exudation or through microbial decomposition after the alga dies. In paddy fields, the death of algal biomass is most frequently associated with soil dessication at the end of the cultivation cycle and algal growth has frequently resulted in a gradual build up of soil fertility with a residual effect on succeeding crop also. The effect of blue-green algae (BGA) on soil nitrogen was carried out from June to December 2005. The BGA inoculum (*Nostoc, Anabaena, Westiellopsis, Aulosira* and *Scytonema*) was used after rice transplantation. After rice harvest, the soil nitrogen was then estimated. The experiment revealed that the N content of the soil with BGA inoculated treatments was comparatively higher than other treatments used in the experiment in which the soil nitrogen was found to be 0.25%.

Key words: Blue-green algae (BGA), inoculum, soil nitrogen.

INTRODUCTION

Blue-green algae (BGA) or cyanobacteria are photo-synthetic prokaryotic microorganisms. They can adopt various soil types, which makes them ubiquitous throughout the world. They prefer temperatures between 25 to 32°C. BGA are found in colonial or filamentous forms. The filamentous forms show heterocystous or non-heterocystous filament. The heterocysts are thick walled, large cells responsible for nitrogen fixation under anaerobic conditions (Fleming and Haselkorn, 1973). It has been demonstrated that nitrogen fertility of soil is sustained better under flooded than under dry condition (Roger, 1984). Cyanobacteria also have a unique potential to contribute to productivity in a variety of agricultural and ecological situations.

Cyanobacteria have been reported from a wide range of soils, thriving both on and below the surface. They are often also characteristic features of other types of sub aerial environment and many intermittently wet ones such as rice fields. The importance of N_2 fixing BGA was first recognized by De (1936) who attributed the self - maintenance of the N status of tropical rice field soils due to the growth of N_2 fixing BGA. The available N of rice soils is increased considerably by the growth of N_2 fixing BGA (De and Mandal, 1950). BGA in fact, bring about directly or indirectly, certain changes in the physical, chemical and biological properties of the soil and soil-water interface in rice fields, which are of agronomic importance.

The main objective of this study was to evaluate the effect of BGA inoculation on soil nitrogen. A large variety of cyanobacteria colonizes rice fields. Some of these strains are equipped with the specialized cells known as heterocysts. These heterocysts are dedicated to the process of nitrogen fixation. Apart from the heterocyst-bearing cyanobacteria, some of the non heterocystous forms also grow profusely in the rice fields. These forms have a tendency to form bundles and settle on soil surface.

MATERIAL AND METHODS

The research work was carried out in the Central Department of Botany, Tribhuvan University, Kathmandu, from June to December, 2005. Soil based BGA mixed inoculum (*Nostoc, Anabaena, Westiellopsis, Aulosira* and *Scytonema*) was used during the transplantation of rice (NR 10414) as previously described by Prasad and Prasad (2003). Altogether, five treatments were used namely; T1, control; T2, NPK (80:30:30 kg/ha); T3, BGA mixed inoculum (10 kg/ha); T4, N: P: K (30:20:20 kg/ha); T5, BGA + N: P: K (30:20:20 kg/ha). The treatments were accommodated in a

*Corresponding author. E-mail: yp_paudel@yahoo.com.

Abbreviation: BGA, Blue-green algae.

Table 1. Analysis of variance (ANOVA) of soil nitrogen.

Source of variation	Sum of square	Df	Mean square	*F*-value	Significance
Between groups	0.006	4	0.001	25.00	0.000
Within groups	0.001	10	0.000		
Total	0.007	14			

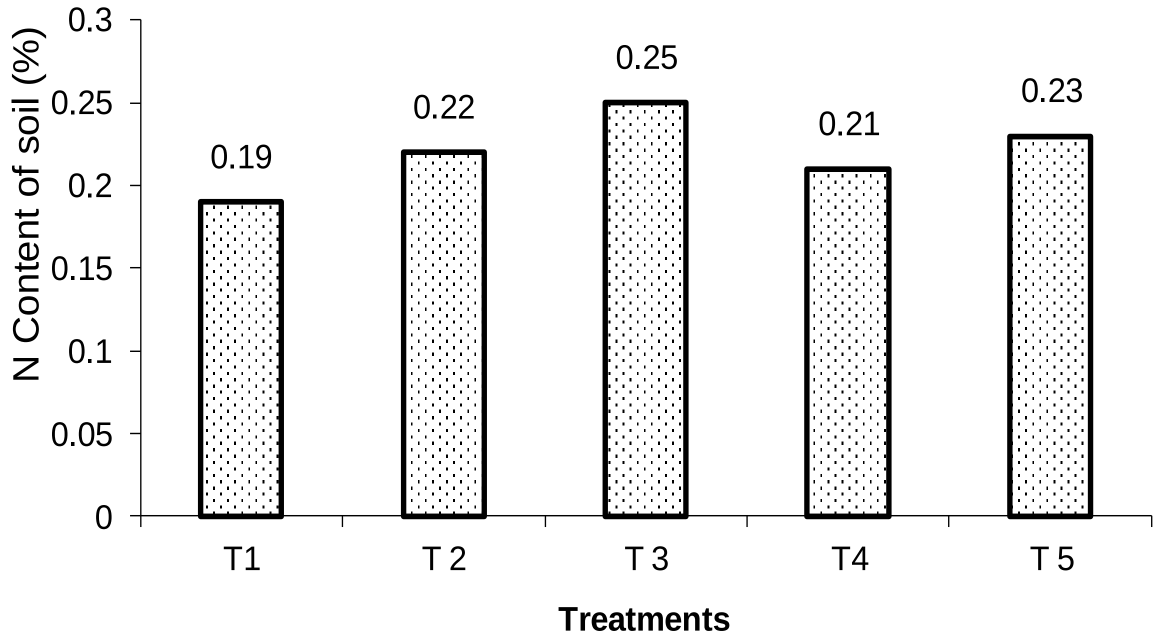

Figure 1. Nitrogen contents of the soil samples in different treatments.

complete block design each with three replications. After the harvest of rice, the soil samples were collected and the total nitrogen of inoculated and uninoculated treatments was estimated by modified Kjeldahl method (Jackson, 1973).

$$N (\%) = \frac{(T - B) \times 14 \times N \times 100}{\text{Weight of sample (g)}}$$

Where, T is the volume of acid used for the titration of sample; B is the volume of acid used for titration of blank and N is the normality of the acid used.

Statistical analysis

The data were analyzed by using the statistical package for social scientist (SPSS) computer programme. The significant differences between the treatments were analyzed using analysis of variance (ANOVA) one way classification system.

RESULTS AND DISCUSSION

The experiment revealed that the N content of the soil with BGA inoculated treatments was comparatively higher than other treatments used in the experiment (Table 1). In T3, the N was found to be 0.25%, whereas the lowest nitrogen content was found in T1 (o.19%). Figure 1 shows the nitrogen contents of the soil samples in different treatments. In the T1 (control treatment without BGA and any fertilizer), the nitrogen was found to be 0.19%. In T2 with NPK (80:30:30 kg/ha), nitrogen was 0.22%, while T3 with BGA mixed inoculum (10 kg/ha) showed 0.25% nitrogen. In addition, T4 with N: P: K (30:20:20 kg/ha) revealed 0.21% nitrogen and T5 with BGA + N: P: K (30:20:20 kg/ha) resulted in 0.23% nitrogen.

Blue-green algae are reported to contribute to the higher nitrogen fertility of rice fields. They grow on the surface of paddy soil and water enriching with good source of nitrogen (Alexander, 1975; Baral et al., 1988). The role of BGA in supplying nitrogen to rice fields is well documented. Addition of fertilizer to rice fields generally leads to accelerated growth of algae. Cyanobacteria form a major component of the flora so long nitrogen content is very high. If high nitrogen fertilizer is used, green algae tend to dominate the soil flora. Moreover, surface application of fertilizer generally checks the growth of cyanobacteria, but deep placement of urea does not prevent their growth.

The lowest N content in the soil of control pot (T1) was probably due to the insufficiency of the source of the nitrogen, while the highest amount of soil N in the treatment T3 was obviously due to the additional supply of nitrogen in soil by BGA. In water logging condition, the BGA multiplied, fixed atmospheric nitrogen and released into the surroundings. Blue-green algae serve to be an asset to the agricultural lands. They represent self supporting microorganisms capable of performing photosynthesis and provide energy for nitrogen fixation. Nitrogen fixed by blue-green algae is released into the soil either through exudation or through microbial decomposition of the dead algal cells. Release of nitrogen through the latter process provides the principal source of nitrogen available to the plant.

In the present experiment, the increase in N by BGA was found to be 31.58% more than the control, and the soil nitrogen was found to be significant ($P<0.05$). Gurung (2004) reported increase in soil N due to BGA inoculation by 4.76% in pot experiment. Prasad and Prasad (2003) also reported 44.37 kg/ha N yield added by BGA. The lower amount of soil N in the treatments containing chemical fertilizers and BGA was possibly due to the inhibitory effect of chemical nitrogen and potash on BGA growth and its N_2 fixation activity, as previously reported (Stewart, 1964; Venkataraman, 1979; Manna, 1986; Kaushik, 1990; Roger, 1984).

REFERENCES

Alexander M (1975). Nitrogen fixation by free living Micro-organisms. Stewart WDP (ed.), Cambridge University Press, Cambridge, p. 175.

Baral SR, Mishra DK, Kumar HD (1988). In situ nitrogen fixation rates in ten rice fields of Kathmandu valley, Nepal. In Biofertilizers: Potentialities and problems. Naya Prakash, Culcutta, India: 103-107.

De PK (1936). The problem of the nitrogen supply of rice. I. Fixation of nitrogen in the rice soil under water logged condition. Indian J. Agric. Sci. 6:1237-1242.

De PK, Mandal LN (1950). Fixation of nitrogen by algae in rice soils. Soil Sci. 81:453-458.

Fleming H, Haselkorn R (1973). Differentiation in Nostoc muscorum-Nitrogenase is synthesized in heterocysts. Proc. Natl. Acad. Sci. 70:2727-2731.

Gurung S (2004). Effect of Azolla and Cyanobacteria (BGA) in rice productivity. M.Sc. Dissertation.

Jackson ML (1973). Soil chemical analysis. Pretice Hall Ind. Pvt. Ltd. New Delhi, pp. 151-153.

Kaushik BD (1990). Algal biofertilizer. In: Biofertilizer Eds Somani *et al.* Scientific Publishers, Jodhpur, pp. 137-154.

Manna AB, Singh PK (1986). Nitrogen fixation of Azolla pinnata in presence of combined N in rice field. In current status of Biological N2- fixation, HAU, Hissar, India, pp. 209-210.

Prasad BN, Prasad RC (2003). Blue Green Algal inoculation for rice productivity and soil fertility in Nepal. J. Nepal Biotechnol. Association. Vol. 1.

Roger PA (1984). Effect of urea on the N2- fixing flora in lowland rice at ripings stage. IRRN, 9(2): p. 28.

Venkataraman GS (1979). Blue green algae in rice cultivations: An evaluation In: Glimpses in plant research. Eds. Nair PKK, Vilas, Publ. (4): p. 74.