Short Communication

Effect of blue-green algae on soil nitrogen

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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 photosynthetic 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 N₂ 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 N₂ fixing BGA. The available N of rice soils is increased considerably by the growth of N₂ fixing BGA (De and Mandal, 1950). BGA in fact, bring about the N status of tropical rice field soils due to their characteristic features of other types of sub aerial environment and many intermittently wet ones such as rice fields.

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

Abbreviation: BGA, Blue-green algae.

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

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of square</th>
<th>Df</th>
<th>Mean square</th>
<th>F-value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between groups</td>
<td>0.006</td>
<td>4</td>
<td>0.001</td>
<td>25.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Within groups</td>
<td>0.001</td>
<td>10</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.007</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

**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 (0.19%). 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.
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 N₂ fixation activity, as previously reported (Stewart, 1964; Venkataraman, 1979; Manna, 1986; Kaushik, 1990; Roger, 1984).

REFERENCES