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Full Length Research Paper

Desirable Effects of Azolla and Blue-Green Algae in Rice cultivation in Davangere District Karnataka. India

Prabhavathi S. Horadi¹

Assistant Professor & H.O.D of Botany, A.V.K College for Women Davangere. Karnataka-577004, India.

ARTICLE DETAILS

Corresponding Author:
Prabhavathi S. Horadi

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ABSTRACT

Pit/Container like plastic tub Experiments were conducted to evaluate the potentiality of Azolla and Blue Gresa Algae as bio fertilizers for rice productivity. Blue Green Algae inoculation increased grain yield by 15% and straw yield by 11%, Azolla showed Increment by 26% in grain yield and by 20% nestraw yield Azolla and Blue Green Algae showed considerable increased in the N-content of soil, grain and straw, Azolla double incorporation was found more effective than other methods of application.

1. Introduction:

Aquatic fern Azolla is one of the interest are a bio fertilizer for wet land rice It is the comen and widely practiced in other countries also. Intensive agriculture based on synthetic inputs popularly known as "Green Revolution has practically replaced our traditional natural renewable resource based agriculture in over last 40 years. Although, the initial results of this technology was very exciting and resulted into four fold increase in production but all this success has come on the cost of future generations and our environment. Biotechnological harvesting of microbial potential in nutrient mobilization and plant protection is one of the widely acclaimed options, which suits both the requirement of optimum production and environment sustainability. Use of microbial system for nutrients mobilization, popularly known as bio fertilizers are getting popular day by day and new systems are being introduced to meet our requirements of different crops and under different cropping systems. Rice (*Oryza sativa*) is the major food crop of nearly half of the world's population, It is the most important crop of India and it fulfills 31% of calorie requirement of Indian population. In India rice is cultivated in 44.0 million hectares (mha) of land and it contributes 43 and 46% of the total food grain and carnal production, respectively. Among the rice growing countries of the world.

India has the largest area under rice, however it stands second next to China on its production (FAOSTAT, Database, 2007). Generally, urea is applied as nitrogen source for rice production. But the efficiency of added urea-N is very low, often only 30-40% (Singh, 1988, Choudhary et al 2002). This low Neuse efficiency is mainly due to denitrification, NH, volatilization and leaching losses (Ponnamperuma, 1972. De Dutta and Buresh, 1989).NH, volatilization and denitrification cause atmospheric pollution through the production of green-house gases like N₂O and NH (Reeves et al., 2002), NH, leaching also ground water toxicity (Shrestha and Ladha, 1998). In addition to these environmental problems, the long- term use of Uren might deplete soil organic matter. These problems are of great concern to soil and environmental scientists around the world. Hence, alternate sources of nitrogen should be applied to minimize these problems. Biological nitrogen fixation (BNF) technology can play an important role in substituting for commercially available nitrogen fertilizer used in rice cultivation. Biological nitrogen fixers like Azolla and cyanobacteria can be the ultimate solution for proper rice production. Azolla commonly known water velvet is a small delicate free floating fern. Azolla is a genus of Leptosporangiata, an aquatic fern that harbors a heterocyst forming, nitrogen fixing blue-green alga, *Anabaena azollae* as a symbiotic in the dorsal lobe cavity. Azolla insymbiosis with the cyano bacterium *Anabaena azollae* fixes substantial amounts of nitrogen and is of great agronomic significance (Roger and Kulasooriya, 1980; Watanabe, 1984; Singh, 1977, 1985, 1989). Cyanobacteria or Blue-

¹Corresponding Author can be contacted at: Assistant Professor & H.O.D of Botany, A.V.K College for Women Davangere. Karnataka-577004, India.

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Green algae (BGA) are photosynthetic prokaryotic micro-organism capable of fixing atmospheric nitrogen (N.) using sunlight as the sole energy source. BGA are distributed worldwide and contribute to soil fertility in many agricultural ecosystems. BGA can adapt to various soil types and environments which have made it cosmopolitan in distribution. The importance of BGA in nitrogen nutrition of rice has earlier been reported by various workers (Singh, 1961; Singh, 1985; Venkataraman, 1972; Singh and Bisoyi, 1989; Kaushik, 1990). Efficient nitrogen fixing strains like *Nostoc linkia*, *Anabaena variabilis*, *Aulosira fertilissima*, *Calothrix* sp., *Tolypothrix* sp. and *Sytonema* sp. were identified from various agro-ecological regions and were utilized for rice production (Roger and Ladha, 1992; Singh, 1988; Kannaiyan et al., 1997; Kennedy and Islam, 2001). Azolla and BGA both have been reported to be effective in improving the organic content of soil, phosphorus availability in soil as well as improve the physical properties of soil (Mandal et al., 1999; Singh et al., 1981). In the present study an attempt has been made to evaluate the potential of Azolla and cyanobacteria as bio fertilizer for rice production.

2. Materials and Method

Pit/Container like plastic tub experiments were conducted at Department of Botany, AVK College for Women Davangere, Karnataka-577004, India. The seed of rice variety (Mahsuri 3022) were procured from G.K.V.K. Bangalore. A mixture of blue-green algal strains (*Nostoc*, *Anabaena*, *Gleocystis*) were collected from the rice fields and after identification and purification they were used for large scale production. The BGA grown in small tanks under field conditions were used as bio fertilizer inocula. *Azolla pinnata*, a dominant strain of Azolla available in the rice field (which can withstand high temperature) was also collected and produced in mass in the clay pot. Soil was collected from top 30 cm of the fields were thoroughly mixed, sieved and part of the soil washed for physico-chemical analysis; determination of pH (at 1:2 soil water ratio) by Systronics expanded Scale pH meter, total nitrogen by modified kjeldahl method (Jackson, 1973). Organic Carbon was analyzed by Walkley and Black's Method (Jackson, 1967). Urea and single super phosphate (SSP) were used as mineral fertilizer in the experiments. Soil was alkaline (pH-8.8) with low nitrogen (0.003%). Pot experiment contained seven treatments with three replications. The treatments were: T-Control, TBGA inoculation, T-NPK, T- Azolla inoculation, T, Azolla incorporation before transplantation, T, Azolla incorporation after transplantation, T, Azolla double incorporation. Five seedlings of twenty days old seedling of the rice variety Mashuri 3022 were transplanted in each pot containing 8 kg of soil. Azolla was applied @ 2t/ha in the pot. BGA inoculum was applied @ 400 g/acre. Nitrogen was applied in two splits, half nitrogen as basal dose and other half nitrogen as top dressing. The data required for yield attributes were taken before harvest and that for yield was taken after harvest.

3. Results and Discussion

In the pot experiments, all the treatments have shown better performance than the control (Table- 2). Highest grain yield (11.0 g/pot) was supported by NPK treatment which was almost equal to that of Azolla double incorporation (10.8 g/pot). Straw yield was found maximum in NPK treated pots (T3). BGA inoculation (T₂) increased the grain and straw yield by 9 and 10% respectively. In the pot experiment Azolla was utilized in four different ways. Among them Azolla double incorporation (T+) supported highest grain yield (26%) while highest increase (21%) in the straw yield was recorded in the pots where Azolla incorporation was followed by inoculation (Ta). The result in the table clearly reveals that the least nitrogen content was found in the soil and plant materials of the control set (Table-3). Whereas maximum nitrogen in the grain was recorded in NPK treated pots (T3) while it was maximally recorded in soil and straw in Azolla double incorporation pots (T). The poor yield in the control set might be attributed to the unavailability of sufficient nutrient to the control set (Table-2). High grain yield by Azolla inoculation could possibly be due to the good cover and nitrogen supply by Azolla. However, comparatively low straw yield might be due to the hindrance in the growth of plant due to thick Azolla cover. The better grain yield and relatively low straw yield could also be explained on the basis of slow release of nitrogen by Azolla, thus rice plants at its early stage do not get sufficient nitrogen which is essential for better vegetative growth. Our results are also supported by Watanabe et al. (1997), where slow release of nitrogen by Azolla is accounting for better grain yield. Interestingly, Azolla double incorporation gave better yield than on its inoculation which could simply be due to the additional supply of nitrogen to the crop (Table-2). Better results by Azolla incorporation than inoculation have also been reported by (Singh, 1988) and Watanabe et al. (1997). Our findings are also supported by Singh and Singh (1986).

Table-1: Physico-Chemical properties of the soil collected from Davangere, Karnataka..

Sl. No	Parameters	Control Soil
1	Temp (°C)	36.6
2	Moisture (%)	3.62
3	W.H.C. (%)	22.4
4	pH	8.8
5	Organic Carbon (%)	0.03
6	Organic matter (%)	0.051
7	Total Nitrogen (%)	0.003
8	C:N	10.0
9	E.C. (dsm-1)	0.86

Table-2: Effect of biofertilizers in the nitrogen content in rice

Sl. No	Treatments	Total Nitrogen Content (t / ha)		
		Soil	Grain	Straw
1	T ₁	4.2	22.4	20.2
2	T ₂	4.4	23.8	20.8
3	T ₃	5.2	25.0	25.8
4	T ₄	5.4	28.0	23.0
5	T ₅	4.4	22.6	20.6
6	T ₆	5.6	27.0	25.2
7	T ₇	6.0	27.6	26.0
F - test (5%)		Ns	*	*

Table- 3: Effect of biofertilizers in the nitrogen content in rice (control)

Sl.no	Treatments	Plant Height (cm)	Panicle / pot	Weight 1000 grains (g)	No. of Grains/ Panicle	Grain Yield (g) /Pot	% Increase	Straw Yield (g/Pot)	% Increase
1	T ₁	68.2	4.7	21.1	91.4	8.6	100	10.7	100
2	T ₂	74.2	4.7	22.3	98.6	9.4	109.3	11.8	110.3
3	T ₃	78.6	6.3	22.8	115.2	11.0	127.9	14.4	134.6
4	T ₄	76.7	4.7	22.4	100.6	10	116.3	12.3	115
5	T ₅	75.0	4.7	22.1	95.6	8.9	103.5	10.9	101.9
6	T ₆	77.1	5.0	22.7	110.2	10.2	118.6	12.9	120.6
7	T ₇	77.0	5.0	23.2	109.2	10.8	125.6	12.8	119.5

However, the percent of increment varied from the increase reported by Manna and Singh (1990) which could be due to the difference in the rice variety used, climatic and soil conditions and the difference in the amount of Azolla inoculated. The better grain and straw yield by split application was due to the availability of nitrogen to the rice at the early stage as well as the later stages of growth. Similar results were also reported by Whitton and Roger (1989) and Saha (1981), Singh (2010). Where basal dose of nitrogen is utilized for the vegetative growth and the nitrogen supplied as top dressing at the later stages of plant growth is utilized in panicle formation which accounts for higher grain yield. Comparatively poor performance by BGA could be due to their inability to colonize in the climate condition. Singh and Singh (1986) reported that BGA established itself in 40 days after transplantation (DAT) and then increased in biomass till harvest which might be the cause of low straw yield, while Azolla established itself within 30 DAT and then started decomposing and thus releasing nutrients to soil and water earlier. Increase in the nitrogen content of soil and plant material has been reported by many workers. Whitton (2000) reported considerable increase in the nitrogen content of soil incorporated with Azolla. Similarly, Singh et al. (1981) reported increase in nitrogen uptake by grain straw as well

4. Conclusion :

The use of Azolla pinnata and BGA results better yield and improves the nitrogen in rice by biological nitrogen fixation. Overall it can be concluded that Azolla pinnata can be used an alternative source of nitrogen in transplanted rice. Azolla are grown before and after planting rice, fixed sufficient nitrogen to meet the requirement of the rice crop. BGA however, could only replace 30kg Nha supplied as urea. Thus Azolla can be recommended to rice growers as alternative source of nitrogen and BGA could only be used when supplemented with additional chemical nitrogen fertilizer in order to meet the total nitrogen demand of the rice. Thus Azolla and BGA can become an eco-friendly, cost-effective, renewable source of as nitrogen content in soil. They found Azolla more effective than BGA as more nitrogen was supplied by Azolla due to its fast decomposing property.

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