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EFFECT OF CYANOBACTERIA ON GROWTH AND YIELD PARAMETERS IN ORYZA SATIVA, VARIETY (ADT 38)

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ABSTRACT

In this study the effect of cyanobacteria as a biofertilizer on growth and yield attributes of rice (ADT38) were evaluated. The experiments were designed with three replications. The growth parameters such as shoot and root length and yield attributes of rice like plant height, number of tillers, number of panicle and grain weight were observed. The present results suggest that the application of cyanobacteria enhances growth and yield attributes of rice when compared to control. The maximum range of growth and yields parameters were recorded more in cyanobacteria when compared to other treatements. The results of this experiment revealed that addition of cyanobacteria as biofertilizer had significant effects on yield attributes of rice and soil properties.

INTRODUCTION

Cyanobacteria are an ancient group of unique prokaryotic organisms with the ability to perform mutually compatible functions like nitrogen fixation and photosynthesis. Information on the diversity of blue greens is essential to understand the algal dynamics and interaction with other microorganisms. Studies on cyanobacterial diversity have gained much importance especially after the recognition of their role in the natural environment and their ability to provide an alternate source of energy. Moreover, they form simple model for understanding various basic phenomena such as cellular metabolism, synthesis of macromolecular compounds, cell differentiation and regulation of gene expression. The capacity of several cyanobacteria to fix the atmospheric nitrogen is a significant biological process of economic importance (Santra, 1993). Rice, the most widely grown food grain crop, serves as the staple food for about half of the population in world. The rice crop forms the basic economic activity directly or indirectly for about 150 million rural households in India. In Tamil Nadu from 1.4 million ha, 3.2 million tonnes rice was produced with the productivity of 2308kg ha^{-1} during 2003-2004. In India during 2003-2004, 87 million tonnes of rice was produced from an area of 42.41 million ha, with the productivity of 2051kg ha^{-1}. It is estimated that demand for rice in 2010 will be 100 million tonnes and in 2025, it will be 140 million tonnes (Singh, 2004). Rice deserves a special status among cereals as world's most important wetland crop. This global grain provides 35-80% of total calorie uptake to more than 2.7 billion people (Gorantla *et al*., 2005). Rice consumes more than 50 percent of the water used for irrigation in Asia (Barker *et al*., 1999).

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MATERIALS AND METHODS

Soil samples were collected from paddy field in Keerapalayam and Vallampadugai, Cuddalore District,Tamilnadu,India. The collected samples were identified and isolated by using standard methods. The rice seeds were soaked with water and cyanobacteria in separate container. The same experiment was carried out as control without algae (T_1 – control; T_2 – Urea;T_3 – Cyanobacteria; T_4 - Cyanobacteria +Urea). Then 3 seedlings were transferred to pots. One week before and one week after transferring the seedlings, 1 g of mixed wet algal inoculums was added to the soil. After 15 and 30 days, shoot and roots length were measured. Then plants were transferred to another pot. After 60 and 90 days, height of plant was measured and number of tillers, number of panicle and grain were also measured. The significant difference between different groups was analysed statistically using analysis of variance (ANOVA). This was followed by Duncan's Multiple Range Test.

RESULTS

Fig 1 shows growth parameters of rice variety (ADT 38) in different treatments. The results on effect of urea and cyanobacteria on growth parameters of paddy (ADT38) were given 1. During the 15 and 30 days the shoot and root length

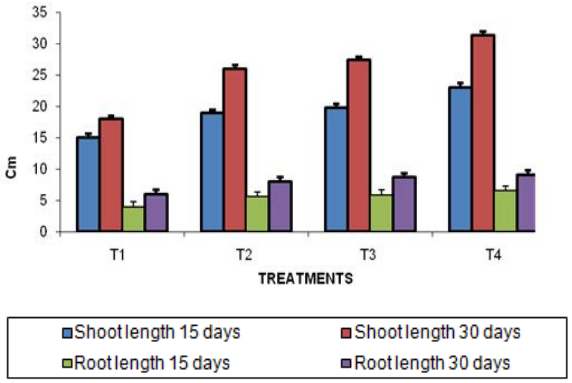

Fig. 1 Effect of cyanobacteria and urea on plant growth of Rice ADT 38

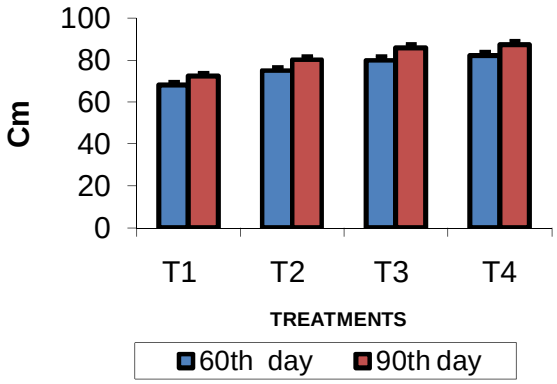

Fig. 2 Effect of organic manures and biofertilizers on growth performance of paddy cultivation (ADT 38)

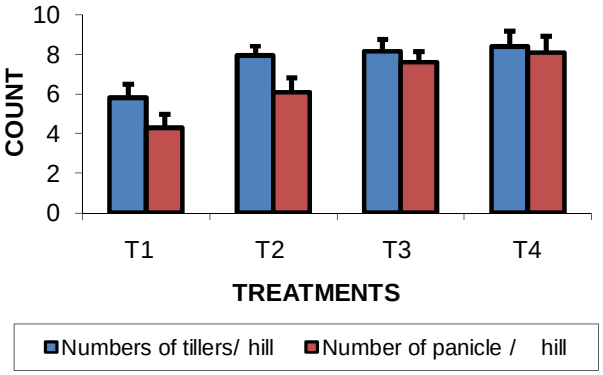

Fig. 3. Effect of organic manures and biofertilizers on growth performance of paddy cultivation (ADT 38)

were measured. The maximum shoot and root length was observed in T_4 treatment (23±0.81 and 6.6±0.67) plants for 15 days of growth and at 30 days of treatments, the maximum shoot and root length was 31.4 ±0.53 and 9.1± 0.67 cm. The minimum shoot and root length was observed in T_1 treatment (15.1±0.54 and 4.0±0.81 cm) plants for 15 days of growth and at 30 days of treatments, the maximum shoot and root length was 18 ±0.53 and 6.0± 0.64 cm. The next maximum shoot and root length was observed in T_3 plants (19.8±0.56 and 5.9±0.76) followed by T_2 plants (19±0.42 and 5.6±0.69 cm) for 15 days and at 30th day treatments, the next maximum shoot and root length was observed in T_3 plants (27.5±0.37 and 8.7±0.62 cm) followed by T_2 plants (26±0.36 and 8.0±0.71 cm) at 30th day.

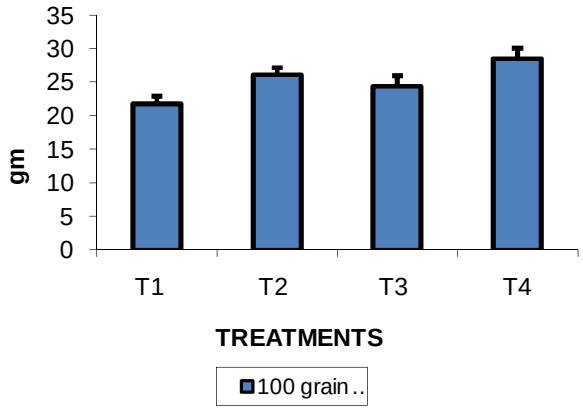

Fig. 4. Effect of organic manures and biofertilizers on growth performance of paddy cultivation (ADT 38)

Fig. 2 shows yield parameters such as plant height was observed in rice variety (ADT 38) at different treatments. The results on effect of urea and cyanobacteria on yield parameters of paddy (ADT38) were given in different treatments periods. The maximum plant height was observed in T_4 treatment (82.01±1.77and 87.21±1.75 cm) plants for 60 days of growth and at 90 days of treatments, the maximum plant height was (87.21±1.75 and 82.01±1.77 cm) observed for 60 and 90 days respectively. The minimum plant height was observed in T_1 treatment (67.9±1.37and 72.1±1.62 cm) for 60 days of growth and at 90 days of treatments. The next maximum plant height was observed in T_3 plants (74.81±1.62and 79.82±1.73 cm) followed by T_2 plants (79.62±1.79 and 85.62±1.79 cm) for 60 days and at 90th day treatments. Fig.3 shows number of tillers and number of panicle was observed in rice variety (ADT 38) at different treatments. The maximum number of tillers/hill was recorded in T_4 pot (8.40±0.78). The minimum number of tillers/hill was recorded in control. The respective number of tillers/hill values (T_1) of control was 5.83±0.67. The next maximum number of tillers/hill values were recorded in T_3, their respective values was 8.17±0.59 followed by T_2 plants (7.95±0.48). The maximum number of panicle/tillers was recorded in T_4 pot (8.10±0.83). The minimum number of tillers/hill was recorded in control. The respective number of tillers/hill values (T_1) of control was 4.3±0.69. The next maximum number of tillers/hill values were recorded in T_3, their respective values was 7.63±0.53 followed by T_2 plants (6.10±0.72). Fig.4 shows the 100 grain weight at different treatments of rice variety (ADT 38). The maximum weight of 100 grain was recorded in T4 pot (28.57±1.51g). The minimum weight of 100 grain was recorded in control. The respective weight of 100 grain (T_1) of control was 21.84± 1.07g. The next maximum weight of 100 grain values were recorded in T_3, their respective values was 24.40±1.62 g followed by T_2 plants (26.09±1.10 g).

DISCUSSION

Cyanobacteria play an important role in maintenance and build-up of soil fertility, consequently increasing rice growth and yield as a natural biofertilizer (Song *et al*. 2005). The paddy field ecosystem provides a favorable environment for

the growth of cyanobacteria with respect to their requirements for light, water, high temperature and nutrient availability. This could be the reason for more abundant cyanobacteria growth in paddy soils than in upland soils (Roger and Reynaud 1982, Kondo and Yasuda, 2003). Blue green algae (BGA) are the diverse group of photosynthetic prokaryotes growing frequently in rice fields, which are known to fix atmospheric nitrogen and to convert insoluble phosphorus into soluble form (Irisarri *et al*., 2001). Cyanobacteria also add organic matter, synthesize and liberate amino acids, vitamins and auxins, reduce oxidizable matter content of the soil, provide oxygen to the submerged rhizosphere, ameliorate salinity, buffer the pH, solubilize phosphates and increase the efficiency of fertilizer use in crop plants (Mandal *et al*. 1998, Kaushik, 2004) Biofertilizer is defined as a substance which contains living microorganisms, when applied to seed, plant surface or soil, colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant (Thamizh Selvi and Sivakumar; Thamizh selvi and Sivakumar,). The excessive use of chemical fertilizers has generated several environmental problems including the greenhouse effect, ozone layer depletion and acidification of water. These problems can be tackled by use of biofertilizers (Choudhury and Kennedy 2005, Rai 2006). Biofertilizers, more commonly known as microbial inoculants, include bacteria (Azotobacter), algae (Blue-green algae) and mycorrhizal fungi; they are natural, beneficial and ecological, and they provide nutrients for the plants and maintain soil structure (Board, 2004). Over the past six decades, reports have been published on the use of cyanobacterial inoculants (algalization) to enhance biological N2 fixation in wetland rice fields. The abundance of cyanobacteria in rice fields has been reported in numerous papers since Fritsch's accounts (Fritsch 1907a, b).

In the present study, the shoot length and root length were observed in ADT 38 rice variety treated with urea and cyanobacteria. The present results suggest that T_4 plant shows an increase in shoot and root length. This may be cyanobacteria as biofertilizer which provide all the necessary elements to the plant and involved in the photosynthesis. The presence of elements strengthens the rice and promotes the growth of rice variety in the soil. The treatments of T4 contain cyanobacteria which indicate the maximum yield might be due to application of cyanobacteria and can supplement more than 20% of nitrogen. Rai *et al*., (2000) reported that cyanobacteria are good colonizers of the nitrogen poor soils, and that through their nitrogen input into the environment and they may help to create habitats suitable for other species. Many cyanobacteria have the capacity to manufacture nitrogenase. Because the enzyme complex is anaerobic, significant fixation by unicellular, colonial and some filamentous species occurs only in the absence of air. Therefore, only heterocystous species are valuable as biofertilizers. Purohit, (2003) reported on the panchagavya foliar spray along with azospirillum and phosphobacteria application in monthly intervals and observed increased plant height, leaf length and yield components of rice his results were also supporting our findings very well. Javaid, (2011) observed that microorganisms used as biofertilizers which increased root, shoot and yields of rice. Kotnala, (2003) reported that blue green algae as a potential source of growth promoter in common Indian rice and plant height and grain yields of rice increased in the cyanobacteria treated plants. Similarly Jalapathi *et. al.*, (1977) also reported the positive effect of cyanobacterialization on reduction of sterility of rice grain. The stimulative and profoundly significant impact of cyanobacterialization through use of cyanobacteria was found to be evident on yield of grain of both the varieties of rice over the control irrespective of the seasons. Sundara *et al*. (1963) have reported the significant contribution of cyanobacteria in boosting up the yield of rice grain particularly in low land rice field. Selvakumar and Sundararaman, (2009) observed that growth and yield potential of rice treated with cyanobacteria *Phormidium fragile* and *Oscillatoria curviceps* showed that shoot and root length of paddy have got significantly increased. They also reported that the highest grain yield was obtained in *Phormidium fragile* treated rice.

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