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APPLICATION OF CYANOBACTERIAL DIAZOTROPHIC TECHNOLOGY FOR PADDY CULTIVATION

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ABSTRACT

The effect of cyanobacterial inoculants, with or without chemical fertilizers was studied on the growth and biomass of paddy crop *Oryza sativa* cv. Sonam. Chemical fertilizers was added in the field as NPK (120:60:60), zinc sulphate@20 kgha^{-1} and cyanobacterial inoculant@12.500 kgha^{-1}.Four plots were selected, in triplicate, for experimental purposes.I-control (without any source of fertilizers) (II) Only cyanobacterial inoculants (III) Only chemical fertilizer (IV) Cyanobacterial inoculants and chemical fertilizer.Paddy growth height and penicle, length and width of leaf. Root length, root dry weight, tiller hill^{-1} and biomass were found superior and statistically significant in the plots treated with cyanobacterial inoculants and chemical fertilizers in comparison to control and individual treatment. Thus, cyanobacterial inoculant with chemical fertilizer showed a progressive effect for grain yield by promoting the crop growth and tillershill^{-1} in combination with chemical fertilizer.

KEY WORDS:: CyanobacterialDiazotrophic Technology, Paddy, Cultivation

Cyanobacteria are photosynthetic prokaryoates which utilise solar energy to reduce atmospheric dinitrogen to ammonia. The ability of cyanobacterial for nitrogen fixation and their effect on rice crop have been carried out by various workers in India and abroad (De 1939, Singh 1961, Venkataraman 1981, Kannaiyan 1995, Watnabe 1966, Youshida *et al*. 1973, Henriksan*et al*. 1975, Mishra and Pabbi 2004). Rodger and Kulsooriya (1980) and Venkatraman (1981) have comprehensively reviewed the ecophysiological and technological aspects of cyanobacteria with special reference to paddy field ecosystem. Rice field in India, being situated in tropical belt, are quite rich in cyanobacterial flora with dominance of *Aphanothece, Anabaena, Aulosira, Cylinderospermum, Gloeotrichia* and *Nostoc* (Singh 1978). In submerged rice field soil biological nitrogen fixation is essentially a cyanobacterial process contributing about 30kg/ha. The biofertilzer technique of cyanobacteria are limited mainly due to non availability of good quality inoculant (Roger and Watanabe 1986). Since the day of realization of biofertilizers potential of cyanobacteria, to date, only the soil-based.Cyanobacterial inoculants are applied to rice crop. Besides increasing N-fertility cyanobacteria benefit rice plant by producing growth promoting substances as observed from the treatment of rice seedling with cyanobacterial culture (Venkatraman, 1972). In the present study attempt have been made to find out the effect of cyanobacteria with or without chemical fertilizers on the growth of rice plant and the result are presented herein.

MATERIALS AND METHODS

Transplantation and Field Preparation

Nursary of *Oryza sativa* (cv. Sonam) was raised during first week of June. The seedlings were uprooted from nursery and 1-2 healthy seedlings were transplanted at one place at a distance of 20 cm from line to line and 15 cm from plant to plant. Well ploughed plots were separated in to four units of earthen bunds for transplantation of seedlings. The treatments included in this study were:

1. Control (without exogenous supplementation of nitrogen fertilizers and cyanobacteria)
2. Only treated with cyanobacteria inoculants
3. Only chemical fertilizers (N.P.K. = 120:60:60) and zinc sulphate@20kg/ha)
4. Cyanobacterial inoculants and chemical fertilizers.

Post Transplantation Operation

(a) Water Management- Crop was grown under well irrigated conditions for the proper growth of cyanobacterial and paddy.

(b) N-Fertilizer- The remaining half of the N-fertilizer @ 30kg/ha (as urea) was applied in to two equal doses. First half dose of fertilizers was applied at tillering stage after 30 days of transplantation. Remaining half dose was applied during

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penicleimitation (after 75 days of transplantation).

(c) Cyanobacterial inoculants- Soil based cyanobacterial culture, obtained from Bio-control Lab. IPM Building Varanasi, was applied @ 12.5 kg/ha in the irrigated field after 10 days of transplantation and field was kept water logged. Proper weed management was carried out and paddy growth was recorded up to the age of penicle formation. Results were statistically analysed for the test of significance

RESULTS

The results on the growth of paddy plant in presented in Table-1.

Table1 : Effect of Cyanobacterial inoculants on the growth of *Oryza sativa* (Cv. Sonam) values are an average of three replicates with ± S.D., 'ANOVA' and level of significance

Field Treatment	Plant height (cm)	Plant height with Penicle (cm)	Penicle (cm)	Leaf Length (cm)	Weadth of Leaf (cm)	Root Length (cm)	Root dry wt (gm)	Tillers. hill^{-1}
Control	73 ± 1.25	93.10 ± 2.15	16.92 ± 0.80	27.9 ± 1.10	1.0 ± 0.40	8.75 ± 1.50	0.98 ± 0.15	14.0 ± 1.45
Control + Cyanobacterial inoculants	84.0 ± 2.90	108.0 ± 4.98	20.0 ± 1.85	36.0 ± 3.25	1.35 ± 0.54	10.55 ± 2.48	1.28 ± 0.95	18.0 ± 1.30
Control + Chemical fertilizers	89.0 ± 4.55	115.0 ± 5.95	24.0 ± 4.00	37.5 ± 1.45	1.90 ± 0.45	17.47 ± 3.10	2.10 ± 0.25	30.0 ± 2.45
Control + Cyanobacterial inoculant + chemical fertilizers	96.0 ± 4.75	126.0 ± 4.00	28.0 ± 6.15	63.85 ± 2.95	2.2 ± 0.52	22.25 ± 2.48	2.75 ± 1.55	39.0 ± 1.48
ANOVA (df = 3) Significance Level	95440.80 P < 0.01	5968.30 P < 0.01	95590.66 P < 0.01	25806.66 P < 0.01	36.45 P < 0.01	3515.76 P < 0.01	78.76 P < 0.01	16910.14 P < 0.01

The plant height was increased 31.5% in the field treated with cyanobacterial culture with chemical fertilizers against control. The field treated either cyanobacterial culture or chemical fertilizers along also showed better growth and the increment in plants height was 15.06% and 21.91% respectively. The increment in plant height was found significant (F = 9544.83, df = 3) at 1% level. Application of cyanobacterial culture with chemical fertilizers proved to be the most suited treatment and supported maximum plant height with penicle (126.6 ± 4.00 cm) against control (93.10 ± 2.15 cm) cyanobacteria inoculated plot (108.0 ± 4.98 cm) (Table,1) and chemical fertilizers (115.0 ± 5.95 cm). ANOVA among the treatment was (F = 5968.30, df = 3) significant at 1% level. Length of penicle leaf length and width of leaves also showed a significant variation against control plot (Table-1). Root length of paddy was found nearly two and half times more in field of cyanobacterial cultural and chemical fertilizers (Table,1) and length was increased 21.7%, 99.65% and 153.14% in cyanobacterial biofertilizers, chemical fertilizer and cyanobacteria and chemical

fertilizer respectively. Root dry weight results also showed the similar trend of result as root length and was significant (F = 78.76, df = 3) at the level of 1% (Table,1).

Number of tillers hill^{-1} gave better response and maximum number was (39.0 ± 1.50) in the field treated with chemical fertilizer and cyanobacterial inoculants in combination against control (14.0±4.09 tiller hill^{-1}). Remaining two field were also superior than control (Table-1). ANOVA among the treatment was (F = 16910.14, df = 3) significant at 1% level.

DISCUSSION

The application of cyanobacterialbiofertilizers alone or in combination improved the plant growth and biomass in comparison to control field (i.e. the field not supplied with any source of fertilizers).

The application of chemical fertilizers along with cyanobacterial biofertilizers significantly increased the plant growth including the size of root and penicle. Water logged paddy field and microanaerobiccondition along with nitrogen fertilizers naturally promote the growth of cyanobacteria.Ammonium chloride equivalent to 100 kg N/ha had no adverse effect on the recovery ofcyanobacterial nitrogen (Venkatraman 1981, Ladha*et al*. 1987). These factors together with secretion of much mucilage and other extracellular products by cyanobacterial may promote the paddy growth and some water holding capacity of soil. It has been shown that fixed nitrogen from cyanobacteria indirectly transferred to rice plant as observed by using 15N/14N tracer technique (Watnabe *et al*. 1977). The production of growth substances and vitamins by cyanobacteria might be responsible for the better growth of plant as reported earlier (Venkatraman 1965, Venkatraman and Neel Kanthan 1967, Adhikari and Sahu 2000). The positive effect of cyanobacteria on the growth of paddy are in confirmity with the above findings. Thus the use of nitrogen fixing cyanobacterial inoculants in paddy field may reduce the load of chemical fertilizers and can give the better growth and yield.

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