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Effect of *Azotobacter* on Rice Crop

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ABSTRACT

Azotobacter treatment to seed, seedling and soil helped good initial plant growth and better tillering of paddy. When applied in combination with 75 per cent of the recommended dose of fertilizer nitrogen, the ***Azotobater*** could compensate 25 per cent of fertilizer N and bring out the same yield of paddy crop as that of cent per cent fertilizer N without ***Azotobacter*** treatment, thereby reducing the cost of cultivation. ***Azotobacter*** treatment with cent per cent of the recommended dose of fertilizer N resulted in the increase of grain yield slightly. ***Azotobacter*** treatment to paddy during January-May season brought out the beneficial effects convincingly than during the August-December season.

INTRODUCTION

Nitrogen is the most difficult of the essential elements to be supplied in sufficient quantities to the crop plants. Despite the greater abundance of nitrogen around the earth in the atmosphere to the tune of 37×10^{14} metric tonnes (Nutman, 1971), it is completely unavailable for the living systems except for a few microorganisms fortunate enough to possess the mechanism for fixing the atmospheric nitrogen. *Azotobacter* is the most important and well known free-living heterotrophic bacterium which plays the beneficial role in agriculture (Allison, 1965; Mishustin, 1970; Nutman, 1971; Brown, 1974). Inoculation of *Azotobacter* to the seeds improved the growth of rice, ragi, peas, wheat and various other crops (Sundara Rao *et al.*, 1963; Mishustin *et al.*, 1963; Brown *et al.*, 1964; Neelakantan and Rangaswami, 1965; Gopalakrishnamurthy *et al.*, 1967; Patel., 1969). In the present context of the escalating prices of nitrogenous fertilizers and their periodic shortages, there is need for exploitation of microorganisms for the benefit of agricultural production. The present paper deals with the usefulness of the *Azotobacter* strains for the rice cultivation under reduced level of fertilizer nitrogen application.

MATERIALS AND METHODS

The strains of *Azotobacter chroococcum* employed in the present studies were isolated from the rhizophere of rice variety (Co 37-Vaigai) under flooded soil conditions. The efficient strains of *Azotobacter* were multiplied in Waksman's medium No. 77 broth for five days in shake culture at 28-30°C and peat soil based inoculants were maintained to contain viable cells around 10^6-10^7/g inoculant. Such peat soil based multistrain inoculants were

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employed for fieldtrials, adopting the following methods of application of *Azotobacter:*

i) **Seed treatment:** Two packets (400 g) of inoculants were mixed with sufficient quantity of water wherein the seeds required for an hectare were soaked overnight. The bacterial suspension after decanting the seeds was poured over the nursery land and then seeds were sown after some time.

ii) **Seedling treatment:** One kg of inoculant (5 packets) is mixed in 30 to 40 litres of clean water and the root portions of the seedlings required for an hectare were dipped in this suspension and transplanted in the main field. By this sufficient load of *Azotobacter* cells was introduced in the root zone where they could multiply and carry out their activities.

iii) **Soil application:** Two kg of inoculants (10 packets) were mixed well with 20 to 25 kg of well decomposed Farm Yard Manure and this further mixed thoroughly with 20-25 kg of soil. The *Azotobacter* - Farm Yard Manure - Soil mixture was then broadcast into the plot (one hectare) where the seedlings were transplanted. By this, the field soil was enriched with large quantity of *Azotobacter* cells which could further multiply and reach the rhizosphere and carry out their activities.

Field trials were conducted at the Paddy Breeding Station, Coimbatore during January - May 1974 and 1975 and August - December 1974 seasons on Co. 37 (Vaigai) variety of paddy. The *Azotobacter* treatments were given in different combinations with the fertilizer nitrogen in the form of urea. The crop was supplied with P and K (60, 60 kg/ha, respectively) in the form of superphosphate and muriate of potash at the basal application. The plant parameters like plant

TABLE I. Effect of Azotobacter treatment on Co. 37 (Vaigai) variety of paddy (Season: January - April, 1974)

Treatment	Plant height (cm)	No. of tillers/ plant	Panicle length (cm)	Grain weight (g/plant)	Grain yield (kg/ha)
T_1 No Azotobacter+120 kg N/ha (control)	90 7	9.4	19.1	11.73	5042
T_2 Azotobacter seed treatment+ 120 kg N/ha	83.3	9.4	19.5	10.17	4842
T_3 ,, Seedling dip+ ,,	90.0	9.5	19.8	10.63	4740
T_4 ,, Soil application+ ,,	92.3	9.5	19.4	12.17	4944
T_5 ,, Seed and seedling+,,	90.5	9.3	17.6	11.00	5185
T_6 ,, Seed and soil+ ,,	91.9	10.4	19.7	13.77	4994
T_7 ,, Seed treatment+ 90 kg N/ha	88.7	7.8	19.3	11.27	4437
T_8 ,, Seedling dip+ ,,	81.7	7.9	19.7	10.07	4643
T_9 ,, Soil application+ ,,	88.9	9.0	20.1	12.83	4793
T_{10} ,, Seed and seedling+,,	88.8	8.8	19.1	10.90	4842
T_{11} ,, Seed and soil+ ,,	89.7	9.0	19.0	11.17	4740

height, number of tillers, panicle length and number of panicles as well as grain yield were collected.

RESULTS AND DISCUSSION

The results from the field trials during different seasons are presented in Table I and II. The plant height and number of tillers at different ages of the crop showed slight variations between the treatments combined with varying levels of fertilizer nitrogen when compared with the control (i. e., no azotobacter treatment + 100 per cent fertilizer N). Similarly panicle length and grain weight per plant showed slight variations between treatments. *Azotobacter* treatment with 75 per cent of the recommended fertilizer N gave more or less same grain yield as that of cent per cent fertilizer N alone. These results from the field trials confirmed the earlier findings of Gopalakrishnamurthy *et al.* (1967).

The *Azotobacter* treatment in combination with cent per cent of recommended fertilizer N caused a slight increase in the grain yield and it varied with the seasons. These results brought out the variations in the yield of grains with the varying levels of fertilizer N at the basal as well as top dressing levels.

Another trial was laid out to understand the effect of *Azotobacter* in combination with varied levels of fertilizer nitrogen at the basal level only while the fertilizer N was applied uniformly during the top dressing. The results (Table III) indicated that the plant height and number of tillers at different age of the crop did not vary significantly between *Azotobacter* treatment with varying levels of fertilizer N and control. Panicle length also did not vary significantly between treatments. The grain yield did not

TABLE II. Effect of Azotobacter treatment on Co. 37 (Vaigai) variety of paddy
Season: August - December, 1974

Treatment	Height (cm)	No. of tillers/ plant	No.of panicles/ plant	Panicle length (cm)	Grain weight (g/plant)	Grain yield (kg/ha)
T_1 No Azotobacter + 120 kg N (control)	65.2	10.4	10.3	16.7	11.06	3931
T_2 Azotobacter Seed treatment + 120 kg N	64.4	10.4	10.3	15.3	10.33	3798
T_3 ,, Seedling dip + ,,	63.4	10.7	10.5	17.4	11.66	3862
T_4 ,, Soil application + ,,	64.3	9.4	10.0	16.5	10.00	3990
T_5 ,, Seed treatment + 90 kg N	63.6	9.4	9.2	16.8	10.33	3454
T_6 ,, Seedling dip + ,,	65.5	9.8	9.4	16.7	9.33	3351
T_7 ,, Soil application + ,,	67.8	9.4	10.0	16.8	10.66	3874
T_8 ,, Seed treatment + 60 kg N	64.2	8.7	8.7	16.2	9.00	3273
T_9 ,, Seedling dip + ,,	64.9	9.3	9.3	16.6	9.00	3327
T_{10} ,, Soil application + ,,	64.7	9.0	9.2	16.9	10.0	3201

TABLE III. Effect of Azotobacter treatment* on Co. 37 (Vaigai) variety of paddy

Season : February - May, 1975

Treatment	Plant height (cm)		No. of tillers/plant		Panicle length (cm)	Grain weight (g/plant)	Grain yield (kg/ha)
	20th day	90th day	20th day	90th day			
T_1 No Azotobacter + 120 kg N/ha (60 basal + 60 top) - Control	48.7	89.0	10.0	11.5	23.2	18.0	6518
T_2 Azotobacter + 120 kg N/ha (60 basal + 60 top)	47.8	90.0	10.4	10.6	22.8	17.3	6601
T_3 Azotobacter + 90 kg N/ha (30 basal + 60 top)	43.2	85.8	9.2	11.1	23.5	16.3	6508
T_4 Azotobacter + 90 kg N/ha (45 basal + 45 top)	42.9	86.6	9.9	10.4	23.6	16.8	6506
T_5 Azotobacter + 60 kg N/ha (0 basal + 60 top)	44.7	89.0	9.6	11.4	22.4	17.8	6143
T_6 Azotobacter + 60 kg N/ha (30 basal + 30 top)	45.5	87.3	9.8	11.9	22.3	17.3	6101

*Azotobacter treatment indicates the application of the bacterium to seed, seedling and soil

get affected significantly by reducing the fertilizer N to the extent of 15 to 30 kg N/ha at the basal dose.

Trials conducted at different seasons indicated more or less similar trend. However, the performance of *Azotobacter* was quite encouraging during January-May season when the stand of the crop in the field was better. Many of the earlier workers obtained increased yields of different crops due to *Azotobacter* treatment (Mishustin *et al.*, 1963; Sundara Rao *et al.*, 1963; Brown *et al.*, 1964; Patel, 1969). In the present studies it was definitely observed that yield increase was slight or no increase with regard to paddy crop, when *Azotobacter* treatment was combined with cent per cent of the fertilizer nitrogen. However, the grain yield was not affected by reducing the fertilizer N to the tune of 25 per cent indicating a saving of fertilizer nitrogen by the application of *Azotobacter*.

REFERENCES

ALLISON, F. E. 1965. Evaluation of incoming and outgoing process that affect soil nitrogen. In : *Soil Nitrogen* (Ed.) W. V. Bartholomew and F. E. Clark, *Amer. Soc. Agron*. Wisconsin, pp : 573-603.

BROWN, M. E. 1974. Seed and root bacterization. *Ann. Rev. Phytopath.*, 12 : 181-197.

BROWN, M. E., S. K. BURLINGHAM and R. M. JACKSON, 1964. Studies on *Azotobacter* species in soil. III. Effects of artificial inoculation on crop yields. *Pl. Soil*, 20 : 194-214.

GOPALAKRISHNAMURTHY, A., A. MAHADEVAN and G. RANGASWAMI, 1967. Effect of bacterization of rice seeds on the rhizosphere microflora and plant growth. *Indian J. Microbiol.*, 7 : 21-28.

MISHUSTIN, E. N. 1970. The importance of non-symbiotic nitrogen fixing microorganisms in agriculture. *Pl. Soil.*, 32 : 545-554.

MISHUSTIN, E. N., A. N. NAUMOVA and V. G. MARIENKO, 1963. Azotobakterin and its effectiveness. *Izv. timiryazev. Sel' khoz. Akad.*, 4 : 42-54.

NEELAKANTAN, S. and G. RANGASWAMI. 1965. Bacterization of rice and okra seeds with *Azotobacter chroococcum* and establishment of bacterium in the rhizophere. *Curr. Sci.*, 34 : 157-158.

NUTMAN, P. S. 1971. Perspectives in biological nitrogen fixation. *Sci. Prog.*, 59 : 55-74.

PATEL, J. J. 1969. Microorganisms in the rhizosphere of plants inoculated with *Azotobacter chroococcum*. *Pl. Soil*, 31 : 209-223.

SUNDARA RAO, W. V. B., H. S. MANN, N. B. PAUL, and S. P. MATHUR, 1963. Bacterial inoculation experiments with special reference to Azotobacter. *Indian J. Agric. Sci.*, 33 : 279-290.