Studies on Azotobacter. IV. Effect of Azotobacter Inoculation on Paddy

by

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Inoculation of crops with free living bacteria for increasing crop yields has been attempted by several investigators. Increased yields due to *Azotobacter* inoculation were obtained by Karunakar and Rajagopalan (1938) for sorghum, and Sundara Rao *et al.* (1963) for wheat. The study reported in this paper pertains to experiments conducted with a view to find out the effect of *Azotobacter* inoculation on the yield and N uptake in paddy.

Materials and Methods: The experiments were conducted in the green-house in pots with 6 kg of clayey loam soil in each pot. The soil was of average fertility with an initial pH of 7.8 and was collected from paddy fields from wet lands, Central Farm, Agricultural College, Coimbatore. Superphosphate and muriate of potash were added in all the pots to give 30 kg P_2O_5 and 30 kg K_2O / ha as basal dressing. One set of pots was sterilized at 20 lb pressure for 4 hours.

A strain of *Azotobacter chroococcum* isolated from the fields from where the experimental soils were collected was used in the experiment. The strain fixed 12.6 mg N per gm of mannite decomposed, in N free mannitol medium.

Nursery was raised in sterile soil for paddy ADT 27 and 27 days' old seedlings were transplanted to soils kept in pots. At the time of transplanting the soils were inoculated uniformly with a heavy suspension of *Azotobacter* culture.

Azotobacter counts were recorded in these soils by plating soil dilutions on N-free mannitol agar. Total N contents of the soils from all the treatments and replications were estimated initially and at the time of harvest and the yields of both grain and straw were recorded at harvest.

Results and Discussion : a) *Azotobacter counts in soils:* The data on *Azotobacter* counts in soils are given in Table 1.

TABLE 1. ***Azotobacter in soils at different stages of crop growth (Expressed in 100s/g dry soil)***

Stages of crop growth	Sterilised inoculated	Sterilised un-inoculated	Un-sterilised inoculated	Unsterilised un-inoculated	Average for stages
	T_1	T_2	T_3	T_4	
S_1 At transplanting	340	...	340	20	233
S_2 5 days after transplanting	262	...	282	35	186
S_3 At tillering	924	...	328	45	432
S_4 At flowering	375	...	298	60	244
S_5 At harvest	218	...	224	31	157

Conclusion : Stages: S_3 S_4 S_1 S_2 S_5 ; T_1 T_3 T_4

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The *Azotobacter* population in the soils were significantly influenced due to treatments. The population generally decreased in the order sterilized inoculated, unsterilised inoculated and unsterilized uninoculated. Maximum counts were found at the tillering stage of crop growth. The numbers were comparatively higher in the sterilised soil series evidently due to lack of competition from other organisms.

The results indicate that sterile soil is a more favourable medium for the establishment and multiplication of *Azotobacter chroococcum* and that an *Azotobacter* flora could be induced to grow and establish in paddy soils by inoculation. Similar results have been reported by Brown *et al.* (1962) and Neelakantan and Rangaswami (1965).

b) *Grain and straw yields of paddy:* The dry weights of paddy grain and straw at maturity of the crop were recorded and the analysis of the data showed that the differences in yields due to inoculation did not attain the level of significance.

The findings are in agreement with those obtained by several investigators reported by Allison (1947) and are opposed to the findings of the Soviet investigators.

c) *N uptake by paddy crop:* The statistical analysis of the data on the N uptake by the paddy crop at harvest (Table 2) showed that inoculation with *A. chroococcum* did not increase the N uptake by the paddy crop in unsterilesoil.

TABLE 2. *Uptake of nitrogen by paddy crop and amounts of nitrogen fixed by Azotobacter in soil*

Treatments	Nitrogen uptake in mg/plant	Conclusion	Nitrogen fixed in kg/ha	
T_1 Sterile soil inoculated	39.52		25.28	
T_2 Sterile soil uninoculated	30.43	Significant at P=0.01	2.93	Significant at P=0.01
T_3 Unsterile soil inoculated	21.47	T_1 T_2 T_3 T_4	30.30	T_3 T_1 T_4 T_2
T_4 Unsterile soil uninoculate6	19.13	C.D.=7.74	10.17	C.D.=6.39

Similar results have been reported by many workers (Allison, 1947) though Sundara Rao *et al.* (1963) obtained increased N uptake in wheat due to inoculation.

d) *N fixation in soil:* The N fixation in soil was worked out from the N contents of the soil before planting and at the end of the harvest. The results calculated in kg/ha are given in Table 2.

A, chroococcum fixed about 14 to 20 kg N per hectare. The fixation is more under natural soil conditions as compared to the sterile soil. The removal of available soil N by the crop in the initial stages subsequently creating conditions favourable for N fixation by free living organisms would have been responsible for the appreciable amounts of N fixed in the inoculated soils.

Summary: The results of green house experiments to study the effect of artificial inoculation with pure culture of *A. chroococcum,* on yield and N uptake by paddy are reported. *Azotobacter* could be established and made to multiply in paddy soils by artificial inoculation. Maximum *Azotobacter* counts were found present during the tillering stage of crop growth. No significant effect was found on the yield on N uptake by paddy due to inoculation. The organisms fixed about 14 to 20 kg N per hectare in the paddy soils.

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