

Effect of *Azospirillum* at different levels of nitrogen on yield of rainfed transplanted rice (*Oryza sativa*)

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ABSTRACT

An experiment was conducted at Agricultural Research Station (Paddy), Sirsi, during the rainy seasons of 1997 and 1998, to know the efficacy of *Azospirillum* in conjunction with inorganic nitrogen on yield of rice (*Oryza sativa* L.). The experiment consisted of 8 treatment combinations of 2 levels of *Azospirillum* (no *Azospirillum* and *Azospirillum*) and 4 levels of nitrogen (0, 50, 75 and 100% recommended dose of nitrogen). On an average over 2 years, the grain yield of rice increased significantly with *Azospirillum* treatment (4,957 kg/ha) compared to no-*Azospirillum* treatment (4,394 kg/ha). Similarly, the grain yield of rice increased significantly with increased levels of nitrogen. The grain yield recorded with *Azospirillum* + 75% recommended dose of N (5,330 kg/ha) was significantly higher over that of no *Azospirillum* + 100% recommended dose of N (5,146 kg/ha) but was on a par with that of *Azospirillum* + 100% recommended dose of N (5,460 kg/ha).

Key words : Rainfed transplanted rice, *Azospirillum*, Nitrogen levels

The yield levels of rice in hill zone of Karnataka are decreasing year by year. The production potential of rice depends on the increased use of fertilizers. Integration of inorganic nitrogen fertilizer with biofertilizers reduces the demand of inorganic nitrogen and increases the nitrogen-use efficiency. Recently, *Azospirillum*, a microbial inoculant (biofertilizer), has been tried as one of the components of integrated nutrient-management system. *Azospirillum* culture fixes atmospheric nitrogen and enhances rice yield (Balasubramanian and

Kumar, 1990). The nitrogen gains from biofertilizers are highly variable, depending on soil, environment, nature of native microbial population etc. Hence an experiment was conducted to study the efficacy of *Azospirillum* in conjunction with inorganic nitrogen on rice yield in rainfed, lowland situation in hill zone of Karnataka.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural Research Station (Paddy), Sirsi, during the rainy seasons of 1997 and

1998 to know the efficacy of *Azospirillum* in conjunction with inorganic nitrogen on yield of rainfed transplanted rice. The soil was silty clay loam with low available nitrogen (196 kg/ha), medium phosphorus (20.3 kg/ha) and very low potassium (53.5 kg/ha). The treatments consisted of 2 levels of *Azospirillum* (no *Azospirillum* and *Azospirillum*) and 4 levels of nitrogen (0, 50, 75 and 100% recommended dose of nitrogen). The experiment was laid out in factorial randomized block design with 3 replications. Rice variety 'Abilash' was used for planting. In treatments having *Azospirillum*, *Azospirillum* slurry was prepared by mixing 200 g *Azospirillum* culture and 4–5 litres water. In this slurry, the roots of the seedlings were dipped for 20 min. and then used for transplanting. Nitrogen was applied at the quantity as per the treatments. Recommended dose of nitrogen (RDN) used was 75 kg/ha. Half of the nitrogen was given at transplanting and remaining in 2 splits (25% at tillering and 25% at panicle-initiation stage) as top-dressing. Entire quantity of recommended dose of phosphorus and potassium (75 and 87.5 kg/ha respectively) was given at the time of transplanting. The crop was grown as rainfed crop. Data were recorded on grain yield during both the years and on yield parameters during 1998. The per cent chaffyness was calculated as:

$$\text{Chaffyness} = \frac{\text{Number of unfilled grains}}{\text{Total (filled + unfilled) grains/panicle}}$$

The data were analysed as per the factorial randomized complete-block design by using M-STAT-C programme.

RESULTS AND DISCUSSION

Effect of Azospirillum

The grain yield of rice differed significantly due to *Azospirillum* during both the years. The grain yields were significantly higher with *Azospirillum* compared with no *Azospirillum* (Table 1). The results are in conformity with those of Gopalaswamy *et al.* (1987). The straw yield was also significantly higher with *Azospirillum*. On an average over 2 years, there was 12.8 and 14.8 % increase in grain and straw yield respectively, with *Azospirillum* compared to no *Azospirillum*. The increase in grain yield of rice owing to *Azospirillum* was mainly because of increased yield parameters. *Azospirillum* recorded significantly more panicles/m², grain yield/hill and panicle, test weight and filled grains/panicle compared with no *Azospirillum* treatment (Table 2). This better response of rice for *Azospirillum* dip may be attributed to increased N availability through N fixation by the *Azospirillum* culture. Gopalaswamy *et al.* (1997) reported that *Azospirillum* inoculation promotes early tillering and reproductive growth of rice and significantly increased grain-filling percentage and grain weight/plant at harvest.

Effect of nitrogen

The variation in grain and straw yields due to nitrogen levels was significant (Table 1). The grain and straw yields were increased significantly with increased levels of nitrogen during 1998 and in pooled data. During 1997, the grain yield recorded with 0% recommended dose of N no nitrogen was lowest and was found to be

on par with that of 50% recommended dose of N. Application of 100% recommended dose of N recorded significantly higher grain yield than other nitrogen levels. Similarly, the straw yield was also significantly higher with 100% recommended dose of N. Similar results were reported by Dubey *et al.* (1997) and Gopalaswamy *et al.* (1997). The increase in grain yield was mainly attributed to increased panicles/

m², grain yield/hill and panicle, test weight, filled grains/panicle and reduced chaffiness (%) with increased nitrogen levels (Table 2).

Interaction effect

The interaction effect of *Azospirillum* and nitrogen levels on grain and straw yields was significant (Table 1). The grain yield recorded with *Azospirillum* + no N

Table 1. Effect of *Azospirillum* at different levels of nitrogen on grain and straw yields of rainfed transplanted rice

Treatment	Grain yield (kg/ha)			Straw yield (kg/ha)		
	1997	1998	Pooled	1997	1998	Pooled
<i>Azospirillum</i> (A)						
A ₀ , No <i>Azospirillum</i>	3,375	5,412	4,394	4,892	6,238	5,565
A ₁ , <i>Azospirillum</i>	4,021	5,892	4,957	5,943	6,835	6,289
CD (P=0.05)	150.27	187.03	167.52	200.02	241.79	106.47
Nitrogen (N)						
N ₀ , No nitrogen	3,217	4,528	3,872	4,563	5,164	4,863
N ₁ , 50% RDN	3,400	5,618	4,509	5,175	6,370	5,772
N ₂ , 75% RDN	3,954	6,078	5,017	5,446	7,052	6,249
N ₃ , 100% RDN	4,221	6,385	5,303	6,488	7,559	7,023
CD (P=0.05)	212.51	264.51	115.11	282.88	341.95	150.57
Interactions (A × N)						
A ₀ × N ₀	2,875	4,146	3,510	4,375	4,765	4,570
A ₁ × N ₀	3,559	4,910	4,234	4,750	5,563	5,157
A ₀ × N ₁	3,017	5,415	4,216	4,517	6,058	5,287
A ₁ × N ₁	3,783	5,821	4,802	5,833	6,682	6,258
A ₀ × N ₂	3,558	5,847	4,703	4,808	6,733	5,771
A ₁ × N ₂	4,350	6,311	5,330	5,083	7,372	6,728
A ₀ × N ₃	4,050	6,241	5,146	6,867	7,394	6,630
A ₁ × N ₃	4,392	6,528	5,460	7,108	7,724	7,416
CD (P=0.05)	300.34	374.07	162.79	400.05	483.59	212.93

RDN, Recommended dose of nitrogen

Table 2. Effect of *Azospirillum* at different levels of nitrogen on yield parameters of rainfed transplanted rice during 1998

Treatment	Panicles/ m ²	Grain weight/ hill (g)	Grain weight/ panicle	Filled grains/ panicle	Chaffyness (%)	Test weight (g)
<i>Azospirillum</i> (A)						
A ₀ , No <i>Azospirillum</i>	207.3	16.04	3.34	97.0	21.18	34.08
A ₁ <i>Azospirillum</i>	219.7	17.08	3.74	108.0	19.31	34.93
CD (P=0.05)	6.58	0.511	0.149	4.95	1.460	0.829
Nitrogen (N)						
N ₀ , No nitrogen	181.5	13.76	2.79	81.3	24.96	33.20
N ₁ , 50% RDN	203.0	15.36	3.34	96.2	21.20	34.24
N ₂ , 75% RDN	225.0	17.34	3.77	107.2	16.86	35.42
N ₃ , 100% RDN	244.5	19.78	4.26	125.4	17.97	35.16
CD (P=0.05)	9.30	0.722	0.211	7.00	2.065	1.173
Interactions (A × N)						
CD (P=0.05)	NS	NS	NS	NS	NS	NS

(3,559 kg/ha) was significantly higher than that of no *Azospirillum* + 50% recommended dose of N (3,017 kg/ha) during 1997. In pooled data, the grain yield recorded with *Azospirillum* + no N (4,234 kg/ha) and no *Azospirillum* + 50% recommended dose of N (4,216 kg/ha) was at par. The grain yield recorded with *Azospirillum* + 50% recommended dose of N (3,783; 5,821 and 4,802 kg/ha respectively) was on par with that obtained with no *Azospirillum* + 75% recommended dose of N (3,558; 5,847 and 4,703 kg/ha respectively) during 1997, 1998 and in pooled data. However, the grain yield recorded with *Azospirillum* + 75% recommended dose of N (4,350 and 5,330 kg/ha respectively) was significantly higher than that obtained with no *Azospirillum* + 100% recommended dose of N (4,050 and 5,146 kg/ha respectively) during

1997 and in pooled data. During 1998, the grain yield recorded with *Azospirillum* + 75% recommended dose of N (6,311 kg/ha) was on par with that of no *Azospirillum* + 100% recommended dose of N (6,241 kg/ha). Similarly, the grain yield recorded with *Azospirillum* + 100% recommended dose of N (4,392; 6,528 and 5,460 kg/ha respectively) was on par with that of *Azospirillum* + 75% recommended dose of N (4,350; 6,311 and 5,530 kg/ha respectively) during 1997, 1998 and in pooled data. On an average over 2 years, the extent of increase in grain yield with *Azospirillum* treatment over no *Azospirillum* treatment was 20.6, 13.9, 13.3 and 6.1% at 0, 50, 75 and 100% recommended dose of N. The results are in conformity with those of Gopalaswamy *et al.* (1997), who reported that *Azospirillum* inoculation along with 75 kg N/ha significantly in-

creased the grain yield of rice. They also reported that at 100 kg N/ha, *Azospirillum* treatment did not have significant beneficial effect. The trend in straw yield was also almost similar to that of grain yield.

It can be concluded that combination of *Azospirillum* + 75% recommended dose of N would be sufficient to get higher yields of rice under rainfed lowland situation of Karnataka. This helps in reducing 25% recommended dose of N and thereby expenditure on nitrogen fertilizer.

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