

Associative Diazotrophs: Ecology, Identification, and Interaction with Non-Leguminous Plants

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Studies in progress since 1977 showed the frequent occurrence of associative nitrogen-fixing bacteria on the roots of various plants. The genus and type differentiation of diazotrophs depend on soil-climate conditions and the soil cultivation level. Studies on the localization of nitrogen fixers in the root zones showed the highest percentage of acetylene-reducing bacteria to be found in the hystosphere zone of non-legume plants. Active strains of associative diazotrophs were isolated from the rhizoplane and hystosphere of grain and fodder cereals.

The isolates belong to the genera: Azospirillum, Aquaspirillum, Rhodospirillum, Artrobacter, Flavobacterium, Bacillus and Mycobacterium /Table 1/.

Table 1
Associative diazotrophs from different systematic groups and their effect on the biomass of rice

Genus, type of bacteria	Nitrogenase activity		Shoots g/pot	Roots g/pot	Nitrogen uptake	
	in vitro, nmol ethylene/ h/vial	in situ, nmol ethylene/ day/pot			Shoots	Roots
					mg/pot	
<u>Aquaspirillum</u> <u>aquaticum</u>	175	350	12.9	72.9	37.7	67.7
<u>Azospirillum</u> <u>lipoferum</u>	2110	3700	5.8	11.6	74.3	17.7
<u>Rhodospirillum</u> <u>rubrum</u>	64	3900	13.0	9.1	146.0	30.0
<u>Rhodobacter</u> sp.	54	5200	20.5	82.1	65.5	92.0
<u>Arthrobacter</u> <u>mysorens</u>	75	1500	5.2	0	63.7	-

The positive effect of diazotroph inoculation on plant productivity was shown in greenhouse experiments on rice, wheat and sorghum. Strains enhancing the nitrogen uptake from the soil and manure were selected. It was established in tests using manure labelled with ^{15}N that molecular nitrogen, fixed from the air during the first few weeks after sowing, accumulated in the substrate, where the plants were grown.

When inoculated, *Azospirillum* strains survived and their populations increased on the roots during plant growth.

Practical experience gained over several years in trials on 7 species of fodder grasses, sorghum, wheat, barley, oats, potato and maral root indicated a positive plant reaction to inoculation by diazotrophs and showed the specificity of plant interaction with different strains of associative nitrogen fixers. In Table 2 the effect of inoculation by associative N-fixing bacteria on the yield of barley variety Belogorsky and potato variety Nevsky is demonstrated.

Table 2
Effect of inoculation by associative nitrogen-fixing bacteria on
yield of agricultural cultures

Inoculation variant	Yield q/ha	Increase compared to control		
		q	%	LSD _{0.5}
<u>Barley variety Belogorsky</u>				
Control /non-inoculated/	51.3	-	-	
<u>Azospirillum lipoferum,</u> strain 137	64.3	13.0	25.2	9.8
<u>Potato variety Nevsky</u>				
Control /non-inoculated/	441.0	-	-	
<u>Arthrobacter mysorens,</u> strain 7	545.0	104.0	23.3	34.0