Indian J Hill Farmg 12 (1 & 2) : 42–46 (1999)

Effect of Azospirillum Inoculation on Production of Rice Crop In Alfisols of Himachal Pradesh

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ABSTRACT

Azospirillum inoculation alone or in combination with low levels of chemical -N significantly increased grain and straw yield of paddy (Var. Himdhan) in two consecutive years of study in alfisols of Himachal Pradesh. Azospirillum inoculation at N0, N30 and N60 gave yield equivalent to that obtained with N 30, N 60 and N 90, respectively, thereby showing an additive effect of 30 kg Nha-1. However, at doses more than 90 kg Nha-1, no beneficial effect of Azospirillum inoculation was noticed, No residual effect of inoculation was observed on the subsequent wheat crop. (Key words: Direct and residual effects, Azospirillum inoculation, paddy yield, alfisol).

INTRODUCTION

Azospirillum, an associative symbiont is found in loose association within the roots of some members of the family Gramineae including some most important cereals. The field testings of Indian isolates of Azospirillum under different agro climatic conditions in India have shown beneficial inoculation effects on various economically important crops. (Tilak and Subba Rao, 1987; Khan and Akond, 1994; Chauhan, 1995; Suresh *et.al.* 1995). However, no such study has been reported in acid alfisols of Himachal Pradesh where rice is grown as one of the major crops. Hence, keeping concept of integrated nutrient supply involving combined use of biological and chemical resources for plant nutrition in view the present study was undertaken to investigate the supplementary effect of biological nitrogen fixing organism. Azospirillum on the yield of rice (Himdhan) and its residual effect on the succeeding wheat crop (S-308) in alfisols a typically hilly area in Himachal Pradesh.

MATERIAL AND METHODS

Field experiments on rice (var. Himdhan) were conducted as the direct beneficiary crop in kharif 1988 and wheat (S-308) was grown as the subsequent crop in rabi (1988-89) and (1989-90) to evaluate the residual fertility status of the soil, where inoculated seedlings of rice were sown. The experimental site is situated at 32°6' N latitude and 76°3' longitude at an elevation of about 1290 metres above msl. It falls in the mid-hill zone of the Shivalik ranges of Himalayas and characterised by wet temperate climate with total annual rainfall of around 3000 mm and the annual average temperature ranges from 11°C to 35°C. The soil was silty clay-loam in texture deficient in P and K, medium in organic carbon and nitrogen. According to the 7th

approximation System of classification, soils of experimental area fall in the order 'Alfiscls' and sub group Typic Hapludalf. The experiment was conducted in randomized block design with 12 treatments at the research farm of Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The treatments were quadruplicated in plots of 10 m2 (5m x 2m) and the treatments (kg/ha) are as follows:

$T_1 : N_0$
$T_2 : N_0$ + Azospirillum
$T_3 : N_{30}$
$T_4 : N_{30}$ + Azospirillum
$T_5 : N_{60}$
$T_6 : N_{60}$ + Azospirillum
$T_7 : N_{90}$
$R_8 : N_{90}$ + Azospirillum
$T_9 : N_{120}$
$T_{10} : N_{120}$ + Azospirillum
$T_{11} : N_{150}$
$T_{12} : N_{150}$ + Azospirillum

The nitrogen was supplied through Urea in three equal splits at transplanting, tillering and panicle initiation stage. A uniform recommended dose of P and K through single super phosphate and muriate of potash was applied at the time of transplanting. No Azospirillum inoculation was done either in seed or soil before sowing wheat crop. Uniform application of P and nitrogen 90 and 60 kg N/ha was made to the wheat crop. Full dose of P_2O_5 through superphosphate as basal and half the nitrogen i.e. 60 kg N/ha^1 through urea in equal splits. There were two levels of Azospirillum culture inoculation (Asp+ inoculation with Azospirillum and Asp - No inoculation). The roots of three weeks old seedlings of paddy were dipped in a slurry of peat based culture of Azospirillum overnight before transplanting. Crop was harvested, threshed, grain and straw yield were recorded and subjected to standard statistical methods.

Table 1. Effect of Azospirillum inoculation and chemical-N on yield of paddy (kg/ha).

Treatment	Grain yield (kg ha-1)		Straw yield (kg ha-1)	
	1988	1989	1988	1989
Nitrogen levels				
N_0	2094	2573	3606	4253
N_{30}	2570	3172	4905	5100
N_{60}	3124	3955	5855	6198
N_{90}	3460	4433	6679	6927
N_{120}	3719	4674	7094	7284
N_{150}	3830	4720	7243	7433
CD(5%)	155	123	244	255
Azospirillum levels				
Asp	2998	3771	5624	5993
Asp+	3268	4071	6170	6431
CD (5%)	89	71	141	130

Table 2. Interaction effect of Azospirillum inoculation and chemical-N on yield of paddy (kg/ha)

Treatment	Grain				Straw			
	1988		1989		1988		1989	
N/levels (kg/ha)	Asp–	Asp+	Asp–	Asp+	Asp–	Asp+	Asp–	Asp+
N_0	1900	2288	2420	2725	3000	4212	3880	4625
N_{30}	2340	2800	2878	3465	4585	5225	4800	5560
N_{60}	2910	3338	3606	4303	5415	6295	3850	6545
N_{90}	3363	3557	4348	4518	6512	6845	6778	7075
N_{120}	3672	3765	4665	4683	7012	7175	7250	7318
N_{150}	3800	3860	4710	4730	7220	7265	7400	7465
CD (5%)	219		174		348		319	

RESULTS AND DISCUSSION

The grain yield of paddy increased significantly with the increasing levels of N upto 120 kg N/ha in both the years. (Table 1). The results are in consonance with those of Modgal *et.al.* (1982). Similarly a significant increase in grain yield was found with Azospirillum inoculation in both the years.

Azospirillum inoculation increased grain yield at low levels of chemical-N (Table 2) upto 60 kg N/ha as compared to un-inoculated where only chemical-N was applied. Rao *et.al* (1983) and Nayak *et.al.* (1986) also obtained a significant increase in paddy yield due to Azospirillum inoculation at low levels of chemical-N. The observations of Mahapatra and Sharma, (1988), Gopalaswamy *et.al.* (1989) and Surash *et.al.* (1995) also confirm our findings.

Azospirillum inoculation with N0, N30, and N60 gave grain yield equivalent to N30, N60 and N90 thereby showing an additive effect of 30 kg N/ha. At N90 no significant increase in the grain yield of paddy was found with the Azospirillum inoculation as compared to its un-inoculated control which was also at par with the yield obtained at N120. However, no beneficial effect of Azospirillum inoculation was noticed at chemical-N doses more than 90 kg N/ha. This may be ascribed to the fact that higher levels of chemical-N decrease the nitrogenase activity (Rao and Raja Mohan Rao (1983) and Dunigan *et.al.* (1986)

Increasing levels of N resulted in significant increase in straw yield of paddy upto 120 kg N/ha (Table 1) Similarly significant increase in straw yield was observed with Azospirillum inoculation. Similar results have been reported by Nayak et.al.(1986) and Prasad and Singh (1986). Further, Azospirillum inoculation with increasing levels of nitrogen significantly in-

Table 3. Residual effect of Azospirillum inoculation and chemical-N on wheat yield (kg/ha)

Treatment	1988-89		1989-90	
	Grain	Straw	Grain	Straw
N-levels (kg/ha)				
N_0	1648	3240	1730	3348
N_{30}	1627	3241	1650	3460
N_{60}	1572	3043	1680	3142
N_{90}	1627	3326	1766	3518
N_{120}	1603	3173	1782	3470
N_{150}	1595	3347	1774	3602
CD (5%)	111	535	134	522
Azospirillum levels				
Asp–	1609	3217	1742	3368
Asp+	1568	2911	1686	3152
CD (5%)	64	309	78	291

creased straw yield of paddy upto 60 kg N/ha^{-1} over their respective uninoculated controls in both the consecutive years (Table 2). The increase in yield might be due to increased nitrogenase activity (Rao et.al. 1983). Azospirillum inoculation at N0, N30 and N60 gave yield equivalent to that obtained at N30, N60 and N90 respectively thereby showing an additive effect of 30 kg N/ha on straw yield of paddy.

No residual effect of Azospirillum inoculation was observed on the subsequent wheat crop (Table 3). The results on the grain and straw yield of wheat (Table 3) revealed significant difference in the yields obtained from the plots uninoculated or previously inoculated with Azospirillum. Thus, Azospirillum inoculation with low levels of chemical -N helps in increasing production of rice crop up to the extent of 30 kg/ha thereby, showing an additive effect of 30 kg N/ha under agro climatic conditions of Himachal Pradesh.

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