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Short Note

Effect of biofertilizers and nitrogen levels on productivity of wheat (*Triticum aestivum* L.) in mid-hills of Himachal Pradesh

S. C. Negi, B. S. Mankotia, J. Shekhar and P. K. Sharma
CSK Himachal Pradesh Krishi Vishvavidyalaya
Rice and Wheat Research Station, Malan-176 047.

Wheat is the most important cereal crop of Himachal Pradesh occupying an area of 370.6 thousand ha with productivity of 15.74 q ha^{-1} (Anonymous, 2002-03). The role of asymbiotic biofertilizers like *Azotobacter* and *Azospirillum* in fixing atmospheric N_2 in cereals has been very well established by several workers(Sushila and Giri, 2000). In addition, microorganisms also secrete phytohormones (Tilak and Singh, 1994) and build up organic status of the soil, thereby improving availability of other plant nutrients. Growing fertilizer demand of the country and increasing fertilizer prices warrant use of biofertilizers in crop production. Therefore, an investigation was undertaken to study the effect of *Azotobacter* and A*zospirillum* in economizing nitrogen in wheat.

Field experiment was conducted during *rabi* seasons of 1998-99 and 1999-2000 at the Research Farm of CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The area represents the mid-hill sub-humid zone of state. The soil of the experimental site was clay loam in texture, acidic in reaction (pH 5.6), medium in organic C (0.9), available nitrogen (410 kg/ha) and available P (16.5 kg/ha), and high in available K (252 kg/ha). Twelve treatment combinations consisted of seed inoculation with *Azotobacter* and *Azospirillum* and uninoculated control in the main plots, and four levels of nitrogen *viz.* 60. 90. 120 and 150 kg ha^{-1}. The experiment was laid out in split plot design with three replications. Seed was inoculated before sowing @ 15 g culture kg^{-1} seed and dried in shade. Nitrogen was applied in two splits i.e. 1/3rd at sowing and 2/3rd at 1st node stage. 'HPW-89' variety of wheat was sown in mid November during both the years under rainfed conditions.

Seed treatment with *Azotobacter* or *Azospirillum* and application of nitrogen influenced the number of grains per ear and the test weight favourably (Table 1). Seed treatment with *Azotobacter* resulted in significantly more number of grains per ear and 1000-grain weight over uninoculated control in 1998-99. Increase in N level upto 90 kg N ha^{-1} resulted in significant increase in number of grains/ ear and 1000 grain weight in 1998-99. There was significant increase in grain yield of wheat to the tune of 9.6 per cent with *Azotobacter* inoculation due to the increase in number of grains per ear and 1000-grain weight. Further, grain yield increased significantly with N dose up to 90 kg N ha^{-1}, beyond which the yield decreased. Application of 150 kg N ha^{-1} recorded significantly less yield as compared to that at 90 kg N ha^{-1}. Decrease in yield at higher levels of nitrogen has also been reported by Singh *et al.* (1979).

Interaction between the seed inoculation and N levels revealed that *Azotobacter* resulted in significant increase in grain yield at lower levels of N only (60 and 90 kg N ha^{-1}) (Table 2). Inoculation with *Azotobacter* and application of 60 kg N ha^{-1} recorded 16 per cent higher grain yield over control, whereas the increase was only 6 per cent at 90 kg N level. Gill *et al.* (1993) observed increase in grain yield of wheat by 1.5-2.3 q ha^{-1} with *Azotobacter.* Wheat grown with A*zotobacter* and 60 kg N ha^{-1} produced grain yield comparable to that grown without inoculation and 90 kg N ha^{-1} during both the years. In other word, *Azotobacter* resulted in saving 30 kg N ha^{-1}. Response of wheat crop to applied N in presence of *Azotobacter* and in absence of seed inoculation has also been depicted in the Figure. Economy in fertilizer N by using has been reported by Hegde and Dwivedi (1994).

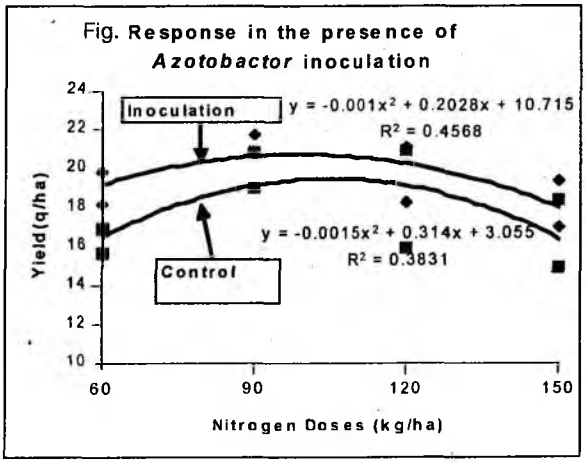
Table 1. Effect of biofertilizers and nitrogen levels on yield and yield attributes of wheat

Treatment	Ears m^{-2} (No.)		Grains ear^{-1} (No.)		1000- grain weight (g)		Grain yield (q ha^{-1})	
	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000
Seed inoculation								
Azotobacter	117	70	43.0	52.2	43.6	40.0	20.2	18.8
Azospirillum	115	64	42.1	52.0	42.8	39.7	19.4	14.3
Control	114	70	41.6	52.3	41.4	39.6	19.2	16.4
CD (P=5.05)	NS	NS	0.7	NS	1.2	NS	0.4	3.0
N levels (kg ha^{-1})								
60	103	64	40.4	50.8	40.8	39.4	17.9	16.3
90	120	67	43.3	52.1	43.7	39.3	20.8	18.2
120	124	71	43.4	52.4	43.5	40.6	21.1	16.2
150	114	69	41.7	53.5	42.5	39.7	18.8	15.2
CD (P=0.05)	NS	NS	0.8	NS	0.9	NS	0.7	1.2

Table 2. Interaction between biofertilizers and nitrogen levels on grain yield of wheat

N level (kg ha^{-1})	Seed inoculation					
	Azotobacter		*Azospirillum*		Control	
	1998-99	1999-2000	1998-99	1999-2000	1998-99	1999-2000
60	19.8	18.2	16.9	15.1	16.9	15.6
90	20.7	21.7	20.9	13.9	20.8	19.0
120	21.1	18.3	21.2	14.4	20.9	15.9
150	19.4	17.0	18.6	13.7	18.4	14.9

CD (P=0.05)	1998-99	1999-2000
N a same seed inoculation	3.8	1.5
Seed inoculation at same or different N	2.1	1.3



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