

EFFECT OF INOCULATION AND LEVELS OF NITROGEN ON GROWTH, YIELD AND QUALITY OF WHEAT (NARMADA-4)

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A field experiment was conducted during the *rabi* season of 1979-80 and 1980-81 at the College of Agriculture Farm, Gwalior (Madhya Pradesh) to study the effect of nitrogen fertilizer and bio-fertilizer on growth, yield and quality of wheat. The grain yield (21.8 q/ha) in the treatment 80 kg N/ha was significantly superior to all other treatments and it was closely followed by 60 kg N/ha (19.8 q/ha). Significant difference in grain yield of wheat was also recorded due to *Azotobacter* inoculation during both the years. Increasing levels of nitrogen increased the grain yield of wheat upto the higher level (80 kg N/ha) tried irrespective of *Azotobacter* inoculation.

Yield of wheat increases with application of nitrogenous fertilizer^S (Reddy and Bharadwaj, 1984) and *Azotobacter* inoculation (Dhingra *et al.*, 1979). Singh and Anderson (1978) also observed that nitrogen application along with *Azotobacter* inoculation increased protein content of wheat. However, there is a paucity of information on the effect of fertilizer nitrogen application along with *Azotobacter* inoculation on growth, yield and protein content of wheat under irrigated condition in Northern Madhya Pradesh.

MATERIALS AND METHODS

A field experiment was conducted in *rabi* season of 1979-80 and 1980-81 at the College of Agriculture, Gwalior. The treatments consisted of five levels of nitrogen (0, 20

40 and 80 kg N/ha and *Azotobacter* inoculation. The treatments were replicated four times in a randomised block design. The spacing between row to row was 20 cm. The soil was a well drained sandy loam with pH 7.9, 115 kg/ha of available N, 18 kg/ha of available P₂O₅ and 325 kg/ha of available K₂O. The inoculant packet of *Azotobacter chroococcum* was obtained from the Division of Microbiology, I. A. R. I. New Delhi. The seeds were inoculated @ 1500 g of culture per hectare. The variety Narmada-4 was sown on 12th, 14th November in 1979 and 1980, respectively. The whole plant and grain samples from individual plots were collected at ear emergence and harvested stage, respectively. Oven dried plants and grain samples were used

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for the analysis of total nitrogen by the micro kjeldahl method (Jackson, 1958).

RESULTS AND DISCUSSION

Effect of nitrogen:

Application of nitrogen increased all the yield attributes significantly. Increase in each levels of nitrogen up to 80 kg N/ha increased the number of tillers and earhead length significantly (Table 1).

Increasing levels of nitrogen significantly increased grain and straw

yield (Table 2) in both the years. The magnitude of increase in grain yield due to application of 20 kg N/ha was more than that of 80 kg N/ha over their respective lower levels; whereas in straw yield the magnitude of increase was higher only at 40 kg N/ha over its lower level at 20 kg N/ha. But the highest significant yield of grain and straw were recorded under the level of 80 kg N/ha in both the years. Similar increase in grain and straw yield of wheat up to 80 kg N/ha was also observed by Reddy and Bharadwaj (1984).

Table 1 Effect of different levels of Nitrogen and *Azotobacter* on yield attributes of wheat

Treatments	No. of tillers/plant			Ear length (cm) at maturity		
	1979-80	1980-81	Mean	1979-80	1980-81	Mean
<i>Nitrogen levels</i>						
<i>(kg/ha)</i>						
0	2.9	2.7	2.8	8.3	6.3	7.3
20	3.9	3.2	3.5	9.9	7.9	8.9
40	4.7	4.6	4.6	11.6	9.6	10.6
60	5.5	5.4	5.4	12.9	10.9	11.9
80	6.4	6.6	6.5	13.7	11.7	12.7
C. D. (5%)	0.19	0.66	—	0.49	0.54	—
<i>Azotobacter</i>						
Uninoculated	4.4	4.1	4.2	10.9	8.9	9.9
Inoculated	5.0	4.8	4.9	11.6	9.6	10.6
C. D. (5%)	0.13	0.42	—	0.31	0.34	—
Absolute control (A. C.)						
(No N P K)	2.3	2.0	2.1	7.5	5.5	6.5
C. D. (5%) for	0.33	1.15	—	0.85	0.93	—
A. C. V/s Nitrogen						
C. D. (5%) for	0.31	1.05	—	0.78	0.85	—
A. C. V/s <i>Azotobacter</i>						

Table 2: Effect of different levels of Nitrogen and *Azotobacter* on yield and economics of wheat

Treatments	Grain yield (q/ha)			Straw yield (q/ha)			Average of two years	
	1979-80	1980-81	Mean	1979-80	1980-81	Mean	Total expenditure (Rs/ha)	Net income (Rs/ha)
<i>Nitrogen levels</i>								
(kg/ha)								
0	8.4	12.7	10.5	17.6	21.3	19.4	1,750/-	318/-
20	13.3	16.5	14.9	26.5	27.2	26.8	1,890/-	1030/-
40	17.6	17.7	17.6	35.4	35.1	35.2	2,010/-	1510/-
60	19.9	19.7	19.8	39.5	40.9	40.2	2,130/-	1842/-
80	22.0	21.6	21.8	42.9	42.7	42.8	2,250/-	2094/-
C. D. (5%)	1.65	1.17	—	1.88	2.62	—	—	—
<i>Azotobacter</i>								
Uninoculated	15.3	17.2	16.2	30.5	32.3	31.4	1,750/-	1470/-
Inoculated	17.1	18.1	17.6	34.2	37.8	36.0	1,790/-	1746/-
C. D. (5%)	0.74	0.74	—	1.19	1.66	—	—	—
Absolute control (A. C.)								
(No N P K)	7.2	10.8	9.0	15.9	16.6	16.2	—	—
C. D. (5%) for A. C.	2.02	2.03	—	3.26	4.54	—	—	—
V/s Nitrogen								
C. D. (5%) for A. C.	1.84	1.85	—	2.97	4.14	—	—	—
V/s <i>Azotobacter</i>								

Total N at ear-emergence stage and crude protein in seed (Table 3) was found to increase significantly with the increasing levels of nitrogen (from 0.90 per cent to 1.63 per cent in nitrogen and 8.54 per cent to 11.67 per cent in crude protein). Such findings were also reported by Dhingra *et al.* 1979. Application of 80 kg N/ha to wheat crop also enhanced the net profit of Rs. 1776.00 per hectare over no nitrogen.

Effect of Inoculation :

Application of nitrogen through bio-fertilizer significantly encouraged the tillers and earhead length over no inoculation. The enhancement in plant growth parameters with *Azotobacter* inoculation was due to synthesis of biologically active substances like Vitamins, auxins and gibberellins etc. that stimulated plant growth parameters (Table-1).

Table 3: Effect of different levels of Nitrogen and *Azotobacter* on total N in plants and crude protein in seed of wheat

Treatments	Total N % at ear emergence stage			Crude protein (%) in wheat seed		
	1979-80	1980-81	Mean	1979-80	1980-81	Mean
<i>Nitrogen levels (kg/ha)</i>						
0	0.84	0.96	0.90	8.74	8.35	8.54
20	1.10	1.22	1.16	10.49	9.57	10.03
40	1.29	1.39	1.34	11.00	10.96	10.98
60	1.42	1.49	1.45	11.16	11.22	11.19
80	1.58	1.68	1.63	11.66	11.69	11.67
C. D. (5%)	0.0383	0.0311	—	0.1120	0.1002	—
<i>Azotobacter</i>						
Uninoculated	1.20	1.31	1.25	10.33	10.13	10.23
Inoculated	1.30	1.39	1.34	10.89	10.58	10.73
C. D. [5%]	0.0243	0.0198	—	0.0707	0.0647	—
Absolute control [A. C.]						
[No N P K]	0.74	0.91	0.82	8.00	7.97	7.98
C. D. [5%] for A. C.						
V/s Nitrogen	0.0662	0.0537	—	0.1894	0.1731	—
C. D. [5%] for A. C.						
V/s <i>Azotobacter</i>	0.0604	0.0490	—	0.1731	0.1581	—

Azotobacter inoculation increased grain as well as straw yield (Table 2) significantly over no inoculation and it was 1.4 and 11.1 q/ha in grain and straw yield respectively. The application of 80 kg N/ha through urea enhanced grain yield by 13.6 q/ha over no nitrogen. While the application of nitrogen through *Azotobacter*, inoculation increased grain yield only upto 1.8 q/ha over no inoculation. This reflects the fact that the effectiveness

of *Azotobacter* inoculant was equal to that obtained through the application of 10.6 kg N/ha. The increase of yield due to *Azotobacter* application might have resulted from the growth regulating and bio-active substances produced by *Azotobacter* as reported by Mishustin and Shilnikova (1969) and similar significant increase in grain yield was also obtained by Dhingra *et al.* (1974).

Azotobacter inoculation also significantly increased the nitrogen content of plant as well as crude protein of seed (Table 3). An average increase in nitrogen content of plant and crude protein content of seed obtained by the application of 1 kg N/ha was 0.009 and 0.04 per cent respectively and by the inoculation the increase was 0.09 per cent in nitrogen content of plant and 0.50 per cent in crude protein of seed. These findings again confirm the effect of *Azotobacter* inoculation up to the limit of 10.6 kg N/ha. Singh and Anderson (1978) also found such *Azotobacter* inoculation response on wheat. *Azotobacter* inoculation also resulted with a higher net profit of

Rs. 276.00 per ha over no inoculation.

Interaction effect :

The interaction effect between nitrogen and *Azotobacter* was not significant. The highest grain yield of wheat was obtained with 80 kg N/ha with and without *Azotobacter* inoculation. However, the grain yield with 60 kg N/ha inoculated with *Azotobacter* did not give grain yield at par with 80 kg N/ha. This suggests that *Azotobacter* did not have response equal to 20 kg N/ha even when it was applied in conjunction with nitrogen fertilizer. This may probably be due to low organic matter content in the soil.

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