

## Efficacy of biofertilizers with nitrogen levels on growth, productivity and economics in wheat (*Triticum aestivum*)

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### ABSTRACT

A field experiment was conducted during the winter season (*rabi*) of 1998–99 and 1999–2000 at Sriniketan, to study the effect of biofertilizers with nitrogen levels on growth, productivity and economics of wheat (*Triticum aestivum* L. emend. Fiori & Paol.). Seed inoculation by *Azospirillum brasilense* or *Azotobacter chroococcum* strains with nitrogen levels significantly influenced the growth attributes, yield attributes and yield of wheat. Use of 75% recommended dose of N along with azospirillum or azotobacter seed inoculation showed at par results when compared with 100% recommended nitrogen (100 kg/ha) towards growth attributes (plant height and leaf-area index), yield attributes (effective tillers/m<sup>2</sup>, ear length and grains/ear) and yield but slightly higher net return and benefit : cost ratio were achieved from 100% recommended dose of N. In red and lateritic soils, seed inoculation with *Azospirillum* or *Azotobacter* strains supplemented 25% of recommended dose of nitrogen (25 kg N/ha) in wheat which reduced the use of inorganic fertilizers with a view to attain an eco-friendly environment.

**Key words :** Inoculation, *Azospirillum*, *Azotobacter*, Growth attributes, Yield attributes, Economics

The substantial increase in crop production achieved through Green Revolution had come through mainly by the use of improved high-yielding crop varieties and greater input of fertilizers and plant-protection chemicals, at the cost of soil health. As a result, in spite of liberal application of NPK fertilizers, a declining or stagnating yield trend was found which might be attributed to multiple nutrient deficiencies and imbalance of nutrients. With the short supply and escalating price of chemical fertilizers, there is an increasing awareness in favour of adopting biological routes of soil-fertility management for preventing soil degradation and for sustaining crop production. In wheat, the integrated approach of nutrient supply by chemical fertilizers along with biofertilizers is gaining importance because this system not only reduces the use of inorganic fertilizers but is also an environment friendly approach. Hence an experiment was conducted to study the effect of biofertilizers with different levels of nitrogen on growth, productivity and economics of wheat.

### MATERIALS AND METHODS

The field trials were conducted during the winter (*rabi*) seasons of 1998–99 and 1999–2000 on sandy-loam soil of Agricultural Research Farm of Pali Siksha Bhavana, Visva-Bharati, Sriniketan. The experiment consisted of 9 treatments, viz. T<sub>1</sub>, uninoculated control; T<sub>2</sub>, *Azospirillum* alone; T<sub>3</sub>, *Azotobacter* alone; T<sub>4</sub>, recommended nitrogen

dose, 100 kg N/ha; T<sub>5</sub>, 75% recommended nitrogen dose + *Azospirillum*; T<sub>6</sub>, 50% recommended nitrogen dose + *Azospirillum*; T<sub>7</sub>, 75% recommended nitrogen dose + *Azotobacter*; T<sub>8</sub>, 50% recommended nitrogen dose + *Azotobacter*; and T<sub>9</sub>, *Azospirillum* + *Azotobacter*, was laid out in randomized block design with each treatment replicated thrice. The soil was slightly acidic in reaction (pH 5.6), low in organic carbon (0.33%), low in available nitrogen (164.2 kg/ha), medium in available phosphorus (41.5 kg/ha) and potassium (165.3 kg/ha). The full quantity of nitrogen was applied @ 100 kg/ha as recommended for the crop. Half of the nitrogen from urea was applied as per treatment at the time of sowing and rest half dose of nitrogen was top dressed after first irrigation. The full quantity of P<sub>2</sub>O<sub>5</sub> @ 40 kg/ha from single superphosphate and K<sub>2</sub>O @ 40 kg/ha from muriate of potash were applied basal in each plot before sowing. The seeds were soaked overnight and the soaked seeds were mixed with biofertilizers like *Azospirillum brasilense* and *Azotobacter chroococcum* sp. as per treatment @ 1.5 kg/ha along with molasses and dried in the shade before sowing. The wheat variety 'UP 262' was sown with a seed rate of 120 kg/ha on 8 December 1998 and 2 December 1999.

### RESULTS AND DISCUSSION

#### Growth attributes

Seed inoculation with *Azospirillum* or *Azotobacter*

strain in combination with different levels of nitrogen responded significantly towards plant height and leaf-area index of wheat (Table 1). In each treatment, an increasing trend in plant height was noticed up to harvest. Leaf area increased with the increasing age of the crop, attained the highest value at 65 days after sowing (DAS) and decreased thereafter. Application of 75% recommended dose of N along with *Azospirillum* or *Azotobacter* inoculation showed at par plant height and leaf area compared with 100% recommended dose of N which might be attributed to improved fertility status through microbial activities and better utilization of plant nutrients by wheat. Singh and Panwar (1997) and Sushila (1998) also reported improved

growth attributes of wheat with *Azospirillum* or *Azotobacter* inoculation.

#### Yield attributes and yield

During both the years, a significant variation was found among the treatments towards yield attributes, grain and straw yields of wheat (Tables 1, 2). Among the biofertilizers, *Azospirillum* proved more effective, as seed inoculation with *Azospirillum* + 75% recommended N dose showed significantly higher number of effective tillers/m<sup>2</sup> and grains/ear in comparison to *Azotobacter* inoculation + 75% recommended nitrogen dose. Sushila and Giri (2000) also reported higher efficiency of *Azospirillum*

**Table 1.** Effect of biofertilizers with different levels of nitrogen on growth and yield attributes of wheat (pooled data of 2 years)

Treatment	Plant height at harvest (cm)	Leaf-area index at 65 DAS	Effective tillers/m <sup>2</sup>	Ear length (cm)	Grains/ear head
T <sub>1</sub> , Uninoculated control	75.7	1.44	202.0	12.0	21.8
T <sub>2</sub> , <i>Azospirillum</i> alone	77.7	2.10	213.9	12.5	23.9
T <sub>3</sub> , <i>Azotobacter</i> alone	76.5	1.68	206.3	12.1	23.6
T <sub>4</sub> , Recommended N dose	98.3	3.71	289.1	13.4	32.3
T <sub>5</sub> , 75% of recommended N dose + <i>Azospirillum</i>	96.1	3.46	305.7	14.2	33.1
T <sub>6</sub> , 50% of recommended N dose + <i>Azospirillum</i>	90.7	2.76	255.0	13.5	27.7
T <sub>7</sub> , 75% of recommended N-dose + <i>Azotobacter</i>	95.8	3.30	285.1	13.3	32.1
T <sub>8</sub> , 50% of recommended N dose + <i>Azotobacter</i>	89.6	2.70	248.6	13.0	25.0
T <sub>9</sub> , <i>Azospirillum</i> + <i>Azotobacter</i>	79.4	1.57	216.1	12.8	23.0
CD (P=0.05)	3.48	0.68	16.35	NS	1.31

DAS, Days after sowing; NS, Not significant

**Table 2.** Effect of biofertilizers with different levels of nitrogen on grain yield, straw yield, net return and benefit : cost ratio of wheat (pooled data of 2 years)

Treatment	Grain yield (tonnes/ha)	Straw yield (tonnes/ha)	Net return (Rs/ha)	Benefit : cost ratio
T <sub>1</sub> , Uninoculated control	0.92	1.80	-2,520	-0.27
T <sub>2</sub> , <i>Azospirillum</i> alone	1.30	2.33	268	0.03
T <sub>3</sub> , <i>Azotobacter</i> alone	1.12	2.13	-1,051	-0.11
T <sub>4</sub> , Recommended N dose	3.16	4.84	13,184	1.27
T <sub>5</sub> , 75% of recommended N dose + <i>Azospirillum</i>	2.95	4.72	11,908	1.18
T <sub>6</sub> , 50% of recommended N dose + <i>Azospirillum</i>	2.39	4.26	8,060	0.81
T <sub>7</sub> , 75% of recommended N dose + <i>Azotobacter</i>	2.90	4.48	11,508	1.14
T <sub>8</sub> , 50% of recommended N dose + <i>Azotobacter</i>	2.26	3.57	6,930	0.70
T <sub>9</sub> , <i>Azospirillum</i> + <i>Azotobacter</i>	1.60	3.00	2,605	0.27
CD (P=0.05)	0.60	1.19	-	-

over *Azotobacter* towards yield attributes of wheat. When compared with recommended dose of N, *Azospirillum* + 75% recommended dose of N showed significantly higher number of effective tillers/m<sup>2</sup>. For ear length and grains/ear of wheat, seed inoculation with *Azospirillum* or *Azotobacter* + 75% recommended N gave at par results when compared with application of recommended dose of nitrogen.

A significant variation was found among the treatments for grain and straw yields of wheat during both the years (Table 2). Application of 75% recommended dose of N along with *Azospirillum* or *Azotobacter* seed inoculation produced at par grain and straw yields of wheat compared with 100% recommended dose of nitrogen. Seed inoculation with *Azospirillum* or *Azotobacter* alone or their mixture resulted higher grain and straw yields of wheat over uninoculated control. Incorporation of biofertilizers not only increased the growth and yield attributes but also increased grain and straw yields of wheat. These increases in yield attributes and yield of wheat through biofertilizers might be attributed to supply of more plant hormones (auxin, cytokinin, gibberellins etc.) by the micro-organisms inoculated or by the roots resulting from reaction to microbial population as reported by Avivi and Feldman (1982). Biofertilizers like *Azospirillum brasilense* or *Azotobacter chroococcum* strains of bacteria supplemented 25% of recommended dose of N in wheat which not only helped reduce the use of chemical fertilizers but also

equalized the yield of wheat when compared with 100% recommended dose of N. Sushila and Giri (2000) also reported similar findings of increased grain yield of wheat with biofertilizers.

### **Economics**

Higher net return and benefit : cost ratio in wheat cultivation were achieved from the use of recommended N dose when compared with 75% or 50% recommended dose of N + seed inoculation with *Azospirillum* or *Azotobacter* strains (Table 2). Seed inoculation with mixture of *Azospirillum* + *Azotobacter* gave higher net return and benefit : cost ratio than *Azospirillum* or *Azotobacter* alone.

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