

Growth, yield and economics of wheat (*Triticum aestivum* L.) as influenced by biofertilizers with nitrogen levels

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ABSTRACT

A field experiment was conducted during the winter season (*rabi*) of 2004-05 at Allahabad Agricultural Institute-Deemed University, Allahabad to study the effect of biofertilizers with nitrogen levels on growth, productivity and economics of wheat (*Triticum aestivum* L.). 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 (120 kg/ha) towards growth attributes (plant height and dry weight), yield attributes (number of effective tillers/plant and number of grains/panicle) and yield. Slightly higher net return and benefit cost ratio were achieved but actual grain yield, straw yield and test weight which was slightly higher from 100 % recommended dose of N. In sandy loam soils, seed inoculation with *Azospirillum* or *Azotobacter* strains supplemented 25 % of recommended dose of nitrogen (30 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.

INTRODUCTION

The substantial increase in crop production achieved through green revolution had come mainly through the use of improved high yielding crop varieties and greater input of fertilizers and plant protection chemicals, which was 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 trial was conducted during the winter (*rabi*) season of 2004-05 on sandy loam soil on Crop Research farm, Department of Agronomy, Allahabad Agricultural Institute-Deemed University, Allahabad. The experiment consisted of 9 treatments, viz., T₁- Uninoculated control; T₂- *Azospirillum* + recommended nitrogen dose (120 kg/ha); T₃- *Azotobacter* + recommended nitrogen dose (120 kg N/ha); T₄-

recommended nitrogen dose *i.e.* 120 kg N/ha; T₅- 75% recommended nitrogen dose (90 kg N/ha) + *Azospirillum*, T₆- 50% recommended nitrogen dose (60 kg N/ha) + *Azospirillum*, T₇- 75% recommended nitrogen dose (90 kg N/ha) + *Azotobacter*; T₈- 50% recommended nitrogen dose (60 kg N/ha) + *Azotobacter*; T₉- *Azospirillum* + *Azotobacter* inoculation was laid out in Randomized Block Design with each treatment replicated thrice. The soil was alkaline in reaction (pH 8.2), poor in organic carbon (0.23 %), low in available nitrogen (181.50 kg/ha), medium in available phosphorus (58.60 kg/ha) and potassium (347.65 kg/ha). The full quantity of nitrogen was applied @ 120 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 P₂O₅ @ 60 kg/ha from single superphosphate and K₂O @ 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*, as per treatment @ 1.5 kg/ha along with molasses and dried in the shade before sowing. The wheat variety PBW-531 was sown at the seed rate of 100 kg/ha on 20th November, 2004.

RESULTS AND DISCUSSION

Growth attributes:

Seed inoculation with *Azospirillum* or *Azotobacter* strain in combination with different levels of nitrogen responded significantly towards plant height. In each

Table 1 : Efficiency of biofertilizers with different levels of nitrogen on plant height at harvest (cm), number of panicles per plant, grain yield (t/ha), straw yield (t/ha), net return (Rs/ha) and benefit cost ratio of wheat

Treatments	Plant height at harvest (cm)	No. of panicles per plant	Grain yield (t/ha)	Straw yield (t/ha)	Net return (Rs/ha)	Benefit: cost ratio
T ₁ Uninoculated control	3.99	78.88	4.991	8.335	20172	2.0
T ₂ <i>Azospirillum</i> + recommended dose of nitrogen	4.33	76.10	5.321	8.686	21138	2.0
T ₃ <i>Azotobacter</i> + recommended dose of nitrogen	3.66	79.20	5.424	8.845	21938	2.0
T ₄ Recommended nitrogen dose 120 kg N/ha	3.88	76.77	6.257	9.463	28168	2.3
T ₅ 75% recommended nitrogen dose + <i>Azospirillum</i>	3.66	89.88	6.250	9.191	28251	2.4
T ₆ 50% recommended nitrogen dose + <i>Azospirillum</i>	3.11	80.99	5.875	8.983	25879	2.3
T ₇ 75% recommended nitrogen dose + <i>Azotobacter</i>	3.77	79.99	5.939	9.119	26038	2.2
T ₈ 50% recommended nitrogen dose + <i>Azotobacter</i>	3.55	76.11	5.421	8.683	22551	2.4
T ₉ <i>Azospirillum</i> + <i>Azotobacter</i>	3.33	79.10	5.523	8.946	24022	2.2
C.D. (P = 0.05)	0.98	7.28	2.79	4.05	--	--

treatment, an increasing trend in plant height was noticed upto harvest (Table 1). Application of 75% recommended dose of N along with *Azospirillum* or *Azotobacter* inoculation showed at par plant height as compared to 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) also reported improved growth attributes of wheat with *Azospirillum*, *Azotobacter* inoculation.

Yield attributes and yield:

A significant variation was found among the treatments towards yield attributes, grain and straw yields of wheat. Among the biofertilizers *Azospirillum* proved more effective as seed inoculation with *Azospirillum* + 75 % recommended N dose tillers per plant, in comparison to *Azotobacter* inoculation + 75% recommended nitrogen dose. Sushila and Giri (2000) also reported higher efficiency of *Azospirillum* over *Azotobacter* towards yield attributes of wheat.

A significant variation was found among the treatments for grain and straw yields of wheat. Application of 75% recommended dose of N along with *Azospirillum* seed inoculation produced at par grain yields of wheat and application of 75% recommended dose of N along with *Azospirillum* or *Azotobacter* seed inoculation produced at par straw yield 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 microorganisms inoculated or by the roots resulting from reaction to microbial population as reported by Avivi and Fieldman (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 75% recommended dose of nitrogen + *Azospirillum* when compared with recommended dose of nitrogen.

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