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# Response of *Triticum aestivum* to an Associative Diazotroph Inoculum under Varying Levels of Nitrogen Fertilizer

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**Abstract**: Response of *Triticum aestivum* to an associative diazotroph inoculum under varying levels of nitrogen fertilizer was studied. Results showed that diazotroph inoculation improved yield and yield components non-significantly. Among NP fertilizer levels 120-50 NP kg ha$^{-1}$ increased no. of tiller m$^{-2}$ (397.750), 1000-grains weight (49.800 g), straw yield (7834.250 kg ha$^{-1}$) and grain yield (4978.750 kg ha$^{-1}$) significantly. The interaction of both the factors was non-significant, nevertheless, maximum grain yield (5271.250 kg ha$^{-1}$) was obtained by seed inoculation + 120-50 NP kg ha$^{-1}$, which was 53 % more over control (No seed inoculation + No fertilizer).

**Key words:** Wheat, diazotroph inoculum, NP fertilizer, yield, agronomic traits

## Introduction

Wheat (*Triticum aestivum* L.) is the most important cereal in Pakistan. It is grown on an area of about 8.46 million hectares with an annual production of 21.08 million tons having an average of 2491 kg ha$^{-1}$ (Anonymous, 2000), which is too low as compared to other wheat producing countries. Among other factors, inadequate crop nutrition is the major, which restricts its yield. In conventional agriculture chemical fertilizers are used to bridge up the gap but there are some problems related to chemical fertilizers, such as shortage at the time of need, adulteration and high cost. Using beneficial micro organisms can solve these obstructions.

Ali *et al.* (1998) concluded that the rice biomass was maximum for azolla (30 kg N + azolla, 7.2 %) followed by bacterial treatment (30 kg N + bacteria, 7.0 %) and minimum was with 60 kg N ha$^{-1}$ (-2.3%). Avijit (1998) reported that yield of wheat was significantly increased by all biozyme + NPK treatments compared with the control, with no significant difference between rates. El-Kased *et al.* (1999) observed that yield of wheat was highest in the biofertilizer treatment, while among N sources the best results were given by urea. Galal *et al.* (2000) concluded that in general inoculation increased the accumulation of shoot dry matter and grain yield of wheat by about 35 %, relative to the control treatment. Lakshminarayana *et al.* (2000) observed that when selected mutants were inoculated on wheat and barley under field conditions, the majority of the derepressed mutants increased grain yield of wheat and barley varying from 1.2 to 33.3 %. Sabir *et al.* (2000) reported that yield and yield components of wheat were significantly affected by fertilizer treatments. Application of 150-100 kg NP ha$^{-1}$ resulted higher grain yield, straw yield, biomass and fertile tillers. Akhtar (2001) concluded that all the yield contributing parameter were the highest when the wheat crop was treated with N in the form of urea. They decreased when N was applied from the organic sources alone or in combination with each other.

Therefore, the research was conducted to investigate the effect of an associative diazotroph inoculum on the yield of wheat with different levels of N fertilizer application under rice- wheat based cropping pattern.

## Materials and Methods

The studies were carried out at the Agronomic Research Station Farooqabad, District Sheikhupura for two consecutive years 1999-2000 and 2000-2001. The characteristics of the experimental soils are given in Table 1:

Table 1: Characteristics of the experimental soils

| Soil characteristics | 1999-2000 | 2000-2001 |
|---|---|---|
| Ece (ds m$^{-1}$) | 1.4 | 1.5 |
| pH | 8.0 | 8.0 |
| Total N (%) | 0.042 | 0.040 |
| Olsen-P (mg kg$^{-1}$) | 7.0 | 7.2 |
| Organic matter (%) | 0.62 | 0.60 |
| Texture | Clay loam | Clay loam |

Experiments were laid out in randomized complete clock design (Factorial) with 4 replication having net plot size 3x5 m$^{-2}$. Wheat variety Punjab-96 was used and the treatments were as follows.

$T_1$ = No inoculation + No fertilizer (control)
$T_2$ = No inoculation + 60-50-0 NPK kg ha$^{-1}$
$T_3$ = No inoculation + 120-50-0 NPK kg ha$^{-1}$
$T_4$ = Diazotrophic inoculation + No fertilizer
$T_5$ = Diazotrophic inoculation + 60-50-0 NPK kg ha$^{-1}$
$T_6$ = Diazotrophic inoculation + 120-50-0 NPK kg ha$^{-1}$

The crop was sown during the 3$^{rd}$ week of November and harvested during last week of April. The wheat seeds were inoculated with diazotroph inoculum (A mixture of *Azotobacter chroococcum* and *Azospirillum lipoferum* mixed at 1:1 ratio) just before drilling. All P and half-N fertilizers were applied at the time of sowing. Second half-N fertilizer was applied with 1$^{st}$ irrigation. All other agronomic practices were kept uniform for all the treatments. Observations regarding various agronomic traits were recorded by using standard procedure. Data were collected and analyzed statistically by using the analysis of variance technique and Duncan's New multiple range test at 5% probability was applied to compare treatment means (Steel and Torrie, 1984).

## Results and Discussion

**Number of tiller m$^{-2}$:** Data (Table 2) indicated that diazotroph inoculation non-significantly improved number of tiller m$^{-2}$ (7.24 %), while response of different levels of N was highly significant. Maximum tillers m$^{-2}$ (397.750) were produced in plot given fertilizer @ 120-50 NP kg ha$^{-1}$, however statistically it was at par with fertilizer rate 60-50 NP kg ha$^{-1}$, while plot applied no fertilizer produced minimum tillers per unit area (309.688). The interaction between various N rates and seed inoculation was non-significant. Sabir *et al.* (2000) and Akhtar (2001) reported almost similar results.

**Number of grain spike$^{-1}$:** Data (Table 2) revealed that different N rates significantly affected the number of grain spike$^{-1}$. Application of 60-50 NP kg ha$^{-1}$ excelled in number of grain spike$^{-1}$ (60.115) but was statistically equal to fertilizer rate 120-50 NP kg ha$^{-1}$ (59.249), whereas no fertilizer application produced only (55.069) grains spike$^{-1}$. Seed inoculation and interaction of both factors was non-significant. Sabir *et al.* (2000) and Akhtar (2001) are partially in accordance with these results.

**1000-Grains weight (g):** Seed inoculation had no significant effect towards 1000-grains weight (Table 2). The different fertilizer levels affected 1000-grains weight significantly. Maximum 1000-grains weight (49.8 g) was produced in treatment 120-50 NP kg ha$^{-1}$, while plot where no fertilizer was given yielded minimum (43.499 g). The interaction of both factors was also significant ($p < 0.05$). Higher 1000-grain weight was obtained from treatment

Table 2: Various agronomic parameters of wheat as affected by diazotroph inoculation and varying levels of N fertilizer

| Treatments | No. of tiller $m^{-2}$ | No. of grain $spike^{-1}$ | 1000-grains weight (g) | Straw yield (kg $ha^{-1}$) | Grain yield (kg $ha^{-1}$) |
|---|---|---|---|---|---|
| **Seed inoculation (A)** | | | | | |
| No seed inoculation ($a_1$) | 354.708 | 58.094 | 46.182 | 6875.458 | 4311.167 |
| Seed inoculation ($a_2$) | 380.375 | 58.194 | 47.636 | 6997.333 | 4544.875 |
| **Fertilizer levels (B)** | | | | | |
| No fertilizer ($b_1$) | 309.688b | 55.069b | 43.499b | 5637.250b | 3610.125b |
| 60-50 NP kg $ha^{-1}$ ($b_2$) | 395.188a | 60.115a | 47.428a | 7337.688a | 4695.188a |
| 120-50 NP kg $ha^{-1}$ ($b_3$) | 397.750a | 59.249a | 49.800a | 7834.250a | 4978.750a |
| LSD value | **50.09 | *3.363 | **2.748 | **978.4 | **699.7 |
| **AxB (Interaction)** | | | | | |
| $a_1b_1$ | 285.250 | 55.132 | 42.513d | 5407.250 | 3434.375 |
| $a_1b_2$ | 398.500 | 60.057 | 49.015ab | 7605.250 | 4812.875 |
| $a_1b_3$ | 380.375 | 59.092 | 47.018bc | 7613.875 | 4686.250 |
| $a_2b_1$ | 334.125 | 55.005 | 44.485cd | 5867.250 | 3785.875 |
| $a_2b_2$ | 391.875 | 60.172 | 45.840bcd | 7070.125 | 4577.500 |
| $a_2b_3$ | 415.125 | 59.405 | 52.583a | 8054.625 | 5271.250 |
| LSD (0.05) value | NS | NS | 3.886 | NS | NS |

*: $p < 0.05$ **: $p < 0.01$ NS = Non significant

combination $a_2b_3$ (Seed inoculation + 120-50 NP kg $ha^{-1}$), while $a_1b_1$ (No seed inoculation + No fertilizer) produced minimum 1000-grains weight. Akhtar (2001) is in agreement with these results.

**Straw yield (kg $ha^{-1}$):** Seed inoculation proved insignificant regarding straw yield (Table 2). On the contrary varying levels of N gave significant results. 7834.250 kg $ha^{-1}$ straw yield was observed by applying 120-50 NP kg $ha^{-1}$ over $b_1$ (No fertilizer). The interaction was also insignificant. Results are quite in line with those obtained by Galal *et al*. (2000) and Sabir *et al*. (2000).

**Grain yield (kg $ha^{-1}$):** The analysis of variance showed non-significant effect of seed inoculation towards grain yield per unit area (Table 2). However, diazotroph bacterial inoculum improved wheat yield non-significantly. Bacterial inoculum produced 4544.875 kg $ha^{-1}$ grain yield compared to 4311.167 kg $ha^{-1}$ without inoculum showing improved yield (5.42 %) due to inoculation. Fertilizer application @ 120-50 NP kg $ha^{-1}$ gave maximum grain yield of 4978.750 kg $ha^{-1}$ significantly ($p < 0.05$) and it was non-significantly improved to 5271.250 kg $ha^{-1}$ in interaction with inoculum. Galal *et al*. (2000), Lakshminarayana *et al*. (2000) and Sabir *et al*. (2000) are quite close to these results. In conclusion, the diazotroph inoculum increases the yield and yield components non-significantly. Among NP fertilizer levels, 120-50 NP kg $ha^{-1}$ proved better one and the highest grain yield was obtained by the application of 120-50 NP kg $ha^{-1}$ along with inoculum.

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