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# Performance of two barley cultivars as affected by nitrogen and bio-fertilizer under newly reclaimed lands

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## ABSTRACT

Two field experiments were carried out at private farm in Wadi El-Rayyan, El- Fayoum Governorate, Egypt in 2015/2016 and 2016/2017 seasons, to study effect of nitrogen fertilizer (ammonia gas 82%) and bio-fertilizer (Azotobacter or Yeast) on growth characters of two barley cultivars (Giza-128 and Giza-129) under newly reclaimed sandy soil. Results could be summarized as follows:

Giza-128 cultivar significant surpassed Giza-129 cultivar in all growth characters under study i.e. plant height "cm", number of tillers/m$^2$, number of spikes/m$^2$, spikes dry weight (g/m$^2$), total dry weight (g/m$^2$), Leaf area (dm$^2$) and leaf area index at 85 and 100 days from sowing.

Adding nitrogen (Ammonia gas 82%) increased significant all growth characters at 85 and 100 days from sowing. Increasing nitrogen fertilizer increased significantly growth characters under study. Adding 75kg N/ fed., produced the highest significant values from growth characters.

Yeast surpassed Azotobacter significantly in all growth characters under study at 85 and 100 days from sowing.

The interaction between barley cultivars and nitrogen fertilizer was significant in all growth characters except number of spikes/m$^2$and spikes dry weight (g/m$^2$) at 100 days from sowing, the interaction between barley cultivars and bio-fertilizer was significant in all growth characters at 85 and 100 days from sowing except plant height (cm) at 85 days from sowing. The interaction between nitrogen fertilizer and bio-fertilizer was significant in all growth characters under study except leaf area index at 100 days from sowing. Data showed that the interaction between barley cultivars x nitrogen fertilizer x bio-fertilizer was significant in all growth characters under study except plant height (cm) at 85 days after sowing. It is clear from results that the most effective treatment for growth characters at 85 and 100 days after sowing was Giza-128 cultivar + 75 kg N/ fed., + Yeast.

***Keywords*:** Barley, cultivars, nitrogen, ammonia gas, azotobacter, yeast, growth characters.

## Introduction

Barley (*Hordeum spp*) was early grown in Egypt since the pre-dynastic period. Now it ranks the fourth in importance among the cereal crops grown in the world. It has been used for several purposes i.e. traditional feed source for animals and more than half of the total production is used that, as a main source for malt in the brewing industry, and as a cereal breakfast and bread, either alone or mixed with wheat, rye or oats. In addition, barley is grown at Sinai and the Northern West Coast zone. Emphasis is given to develop drought and salt tolerant varieties to be grown for such areas. To increase barley yield must raising the yield per unit area by adapting new varieties which excel the present ones and by improving the cultural practices of barley, to give the best production under local conditions. Barley is a widely cultivated cereal crop in the temperate regions. The crop is the most hardy of all the cereal grains. Its cultivation extends farther north than any other crop and at the sometime it can be cultivated in sub-tropical countries (Hussein *et al.,* 2013).

Increasing barley yield can be obtained through breeding programs to produce highly productive and quantitative gene forms; as well as; adjusting to mineral and bio-fertilizer respect to arrive to that strategy. Any factor influencing the metabolic activity of the plant at any period of its growth can affect the yield. Metabolic processes in barley plants are greatly covered by both internal i.e. genetic makeup of the plant and external conditions which namely climatic and edaphically environmental factors. It is obvious that, increasing barley production per unit area can be achieved by breeding and

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cultivating the promising barley cultivars and applying the optimum cultural practices such as suitable fertilizer. There were a significant differences among cultivars (Ahmed *et al.*, 2017 in barley, El-Esh, 2007 and Zaki *et al.*, 2016 in wheat).

Nitrogen is the most limiting factor in crop production and results in higher biomass and protein yields in plant tissue. The efficiency of nitrogen fertilizer increased by using ammonia gas, thus the evaluation the rate of this form to choice the best rate, many investigators reported in this aims (Waseem, *et al.*, 2007, El-Gizawy and Salem, 2010, Zaki *et al.*, 2016 and Hassanein *et al.*, 2018). Many investigators told that biofertilizer (Azotobacter or Yeast) produced significant increment in all growth characters under study (Zaki *et al.*, 2012 and Zaki *et al.*, 2016 in wheat).

The aim of this investigation was designed to study the effect of nitrogen fertilizer (ammonia gas 82%) and bio-fertilizer on growth characters of two barley cultivars under sandy soil.

## Materials and Methods

Two field experiments were conducted during the two seasons of 2015/2016 and 2016/2017 at private farm in Wadi El-Rayyan, El-Fayoum Governorate, Egypt, to study the effect of nitrogen fertilizer (ammonia gas 82%) and bio-fertilizer(Azotobacter or Yeast) on growth of two barley cultivars (Giza-128 and Giza-129) under newly reclaimed sandy soil. Soil samples was taken at depth of 30 cm for mechanical and chemical analysis as described by Chapman and Pratt (1961). The mechanical and chemical analysis of the soil of the experimental site were illustrated in Table (1).

**Table 1:** Mechanical and chemical analysis of soil at experimental sites (Average of 2015 and 2016 seasons).

| Sand% | Silt% | Clay% | Texture | pH | Organic matter O.M.% | Available N ppm | Available K ppm | Available P ppm |
|---|---|---|---|---|---|---|---|---|
| 73.59 | 22.47 | 3.45 | Sandy | 8.00 | 0.49 | 84.00 | 134.00 | 12.5 |

The experimental design was split-split plot design with four replications. Barley cultivars were allocated randomly in the main plots and nitrogen fertilizer were randomly allocated in sup- plots and bio-fertilizer were allocated in sup-sup plot design. The experimental site was ploughed twice and divided into plots of 10.5 $m^2$. Each plot included 15 rows 3.5 m long and 0.2 m apart. Grain of barley were sown on the second week of November in the two seasons. Phosphorus at the rate of 150 kg $P_2O_5$/ fed., in the form of super phosphate (15.5 % $P_2O_5$) was added before sowing. Other agriculture processes were performed according to normal practice recommended by Barley Research Dep., Agric. Research Centre.

The experimental treatments can be described as follows:

Two cultivars (Giza-128 , Giza-129), four treatments including control ( 25, 50, 75 kg N/ fed.) of Nitrogen fertilizer (ammonia gas 82%) and two treatments of Bio-fertilizer (Azotobacter and Yeast).

Samples of five guarded plants were taken random from the middle rows of each plot of the four replication to measure growth characters at 85 and 100 days from sowing, where; plant height "cm", Leaf area ($dm^2$) and leaf area index, also, one meter was taken from each plot to determine number of tillers/$m^2$, number of spikes/$m^2$, spikes dry weight (g/ $m^2$) and total dry weight (g/ $m^2$). Leaves area was determined according to Bremner and Taha (1966), whereas, leaf area index (LAI) was determined according to Watson (1952).

All data were subjected to statistical analysis according to procedure outlined by Gomez and Gomez (1984). Treatments means were compared by L.S.D at 5% level test. Combined analysis was made for the two growing seasons as results followed similar trend.

## Results and Discussion

### Cultivars differences:

Data in Table (2) indicated that significant differences between the two barley cultivars Giza-128 and Giza-129 in all growth characters under study. It is clear that barley cultivar Giza-128 surpassed the other cultivar Giza-129 in all growth characters under study i.e. plant height (cm),

number of tillers/ $m^2$, number of spikes/ $m^2$, spikes dry weight ($g/m^2$), total dry weight ($g/m^2$), Leaf area ($dm^2$) and leaf area index at 85 and 100 days from sowing.

It worthy to mention that the differences between the two barley cultivars Giza-128 and Giza-129 may be due to the genetic structure differences between cultivars Clark *et al.* (1997), Hassanein *et al.* (2014), Zaki *et al*. 2016 and Ahmed *et al.* (2017). These results are in a harmony with those obtained by Abu-Grab *et al.* (2006), Koriem (2008) and Radwan *et al.* (2014) in wheat.

**Effect of nitrogen fertilizer:**

Data in Table (2) showed that all growth characters under study were significantly affected by different rates of nitrogen fertilizer (ammonia gas 82%). It is clear that increased nitrogen fertilizer from zero to 75 kg N/ feddan increased significantly all growth characters i.e. plant height "cm", number of tillers/$m^2$, number of spikes/$m^2$, spikes dry weight (g/ $m^2$), total dry weight (g/ $m^2$), Leaf area ($dm^2$) and leaf area index. The greatest values of all growth characters in both seasons under study was 75 kg N/feddan followed by 50 and 25 kg N/feddan compared the control at 85 and 100 days after sowing (Ahmed *et al.*, 2009, Amin, 2011, Zaki *et al.*, 2012, Zaki *et al.*, 2016 and Hassanein *et al*., 2018).

**Effect of bio-fertilizer:**

Data in Table (2) showed that the bio-fertilizer with Yeast realized significant increase in all growth characters i.e. plant height "cm", number of tillers/$m^2$, number of spikes/$m^2$, spikes dry weight (g/ $m^2$), total dry weight (g/ $m^2$), Leaf area ($dm^2$) and leaf area index under study at 85 and 100 days from sowing. This could be attributed to the role of plant phytohormones like IAA, GA and CKS which promote plant growth, cell division, breaking the special dominances, hence encouraging the phytosynthesis and assimilates accumulation (Hosam El-Din, 2007, Zaki *et al*, 2012, Hassanein *et al*. 2018 and Wali *et al*. 2018).

**Effect of interaction between barley cultivars and nitrogen fertilizer:**

Data in Table (3) indicated that the interaction between barley cultivars and nitrogen fertilizer was significant in all growth characters in both seasons at 85 and 100 days from sowing except number of spikes/ $m^2$ and spikes dry weight ($g/m^2$) at 100 days after sowing which failed to reach the significant level. Data in table (3) illustrated that the effective treatment for plant height (cm), number of tillers ($m^2$), total dry weight ($g/m^2$), leaf area ($dm^2$) and leaf area index at 85 and 100 days from sowing was Giza-128 cultivar + 75 kg N/feddan followed by Giza-129 cultivar + 75 kg N/feddan. These results were in accordance with those obtained by Hassanein *et al*. (2001), Zaki *et al*. (2016) and Hassanein *et al*. (2018).

**Effect of interaction between barley cultivars and bio-fertilizer:**

The effect of interaction between barley cultivars and bio-fertilizer (Azotobacter or Yeast) on growth characters at 85 and 100 days from sowing are presented in table (4).The results revealed that the interaction between barley cultivars and bio-fertilizer was significant in all growth characters at 85 and 100 days from sowing except plant height (cm) at 85 days from sowing. Data showed that the best value for all growth characters i.e. plant height "cm", number of tillers/$m^2$, number of spikes/$m^2$, spikes dry weight (g/ $m^2$), total dry weight (g/ $m^2$), Leaf area ($dm^2$) and leaf area index under study at 85 and 100 days from sowing was obtained from Giza- 128 cultivar + Yeast. These results are in harmony with those obtained by Hassanein *et al*. (2018) and Wali *et al*. (2018).

**Effect of interaction between nitrogen fertilizer and bio-fertilizer:**

Data in Table (5) showed that the interaction between nitrogen fertilizer x bio-fertilizer was significant in all growth characters i.e. plant height "cm", number of tillers/$m^2$, number of spikes/$m^2$, spikes dry weight (g/ $m^2$), total dry weight (g/ $m^2$), Leaf area ($dm^2$) and leaf area index under study at 85 and 100 days from sowing except leaf area index at 100 days after sowing which failed to reach the significant level. The best value for all growth characters at 85 and 100 days after sowing was obtained from 75 kg N/feddan + Yeast inoculation.

**Table 2:** Effect of cultivars, nitrogen fertilizer and bio-fertilizer on growth characters of barely at 85 and 100 days after sowing. (Average of 2015/2016 and 2016/2017 seasons).

| Characters | Plant height (cm) | | No. of tillers ($m^2$) | | No. of spikes ($m^2$) | | Spikes dry weight ($g/m^2$) | | Total dry weight ($g/m^2$) | | LA ($dm^2$) | | LAI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** |
| **Cultivars** | | | | | | | | | | | | | | |
| **Giza 128** | 89.4 | 99.2 | 446.3 | 450.1 | 441.3 | 445.6 | 661.9 | 756.5 | 1204.3 | 1259.8 | 32.64 | 35.13 | 2.97 | 3.21 |
| **Giza 129** | 86.7 | 95.6 | 443.0 | 447.0 | 437.3 | 442.3 | 656.6 | 752.1 | 1196.2 | 1250.5 | 31.18 | 35.15 | 2.85 | 2.97 |
| **L.S.D. at 5%** | 0.7 | 0.5 | 0.7 | 0.5 | 0.2 | 0.3 | 0.4 | 0.4 | 0.4 | 0.5 | 0.18 | 0.33 | 0.05 | 0.22 |
| **Nitrogen fertilizer(Ammonia Gas)** | | | | | | | | | | | | | | |
| **Control** | 83.4 | 92.0 | 438.2 | 441.9 | 432.6 | 437.8 | 646.6 | 744.2 | 1182.7 | 1237.1 | 28.74 | 30.67 | 2.57 | 2.74 |
| **25 kg N/ fed.** | 86.4 | 95.8 | 442.3 | 446.7 | 436.6 | 441.8 | 656.9 | 749.4 | 1194.0 | 1249.8 | 30.91 | 33.14 | 2.82 | 2.99 |
| **50 kg N/ fed.** | 89.6 | 99.3 | 447.3 | 450.6 | 442.2 | 446.2 | 663.8 | 758.7 | 1207.0 | 1260.6 | 32.79 | 35.39 | 3.00 | 3.23 |
| **75 kg N/ fed.** | 92.8 | 102.5 | 450.9 | 455.0 | 445.8 | 450.1 | 669.6 | 764.9 | 1217.2 | 1273.1 | 35.20 | 37.37 | 3.26 | 3.40 |
| **L.S.D. at 5%** | 0.3 | 0.2 | 0.2 | 0.2 | 0.4 | 0.3 | 0.3 | 0.3 | 0.8 | 0.2 | 0.20 | 0.24 | 0.05 | 0.06 |
| **Bio- fertilizer** | | | | | | | | | | | | | | |
| **Azotobacter** | 86.7 | 95.8 | 444.0 | 446.9 | 438.1 | 442.5 | 656.8 | 752.2 | 1195.2 | 1250.1 | 31.06 | 33.18 | 2.86 | 2.96 |
| **Yeast** | 89.4 | 99.1 | 446.4 | 450.2 | 440.5 | 445.4 | 661.7 | 756.4 | 1205.3 | 1260.2 | 32.77 | 35.10 | 2.97 | 3.22 |
| **L.S.D. at 5%** | 0.3 | 0.2 | 0.4 | 0.1 | 0.2 | 0.3 | 0.2 | 0.2 | 0.6 | 0.2 | 0.08 | 0.18 | 0.03 | 0.05 |

**Table 3:** Effect of interaction between cultivars x nitrogen fertilizer on growth characters of barely at 85 and 100 days after sowing. (Average of 2015/2016 and 2016/2017 seasons).

| Treatments | Characters | Plant height (cm) | | No. of tillers ($m^2$) | | No. of Spikes ($m^2$) | | Spikes dry Weight ($g/m^2$) | | Total dry Weight ($g/m^2$) | | LA ($dm^2$) | | LAI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** |
| **Cultivars x Nitrogen fertilizer (Ammonia Gas)** | | | | | | | | | | | | | | | |
| **Giza-128** | **Control** | 84.5 | 93.4 | 440.3 | 443.6 | 434.3 | 439.4 | 649.0 | 746.3 | **1187.5** | 1242.2 | 29.01 | 31.46 | 2.58 | 2.82 |
| | **25 kg N/fed.** | 87.6 | 97.4 | 443.9 | 448.1 | 439.4 | 443.7 | 659.5 | 751.5 | 1197.8 | 1254.7 | 31.62 | 34.32 | 2.86 | 3.16 |
| | **50 kg N/fed.** | 91.0 | 101.2 | 448.9 | 452.0 | 443.8 | 447.9 | 666.4 | 761.0 | 1211.2 | 1264.2 | 33.78 | 36.72 | 3.12 | 3.39 |
| | **75 kg N/fed.** | 94.4 | 104.9 | 452.3 | 456.7 | 447.6 | 451.6 | 672.8 | 767.2 | 1220.5 | 1278.2 | 36.14 | 38.03 | 3.33 | 3.48 |
| **Giza-129** | **Control** | 82.4 | 90.7 | 436.1 | 440.2 | 431.0 | 436.2 | 644.2 | 742.0 | 1177.9 | 1232.0 | 28.47 | 29.89 | 2.57 | 2.66 |
| | **25 kg N/fed.** | 85.2 | 94.2 | 440.8 | 445.2 | 433.9 | 440.0 | 654.3 | 747.4 | 1190.2 | 1244.9 | 30.19 | 31.95 | 2.79 | 2.81 |
| | **50 kg N/fed.** | 88.1 | 97.4 | 445.7 | 449.3 | 440.6 | 444.5 | 661.3 | 756.3 | 1202.8 | 1257.1 | 31.81 | 34.06 | 2.87 | 3.06 |
| | **75 kg N/fed.** | 91.1 | 100.2 | 449.5 | 453.4 | 443.9 | 448.5 | 666.5 | 762.6 | 1214.0 | 1268.0 | 34.27 | 36.72 | 3.18 | 3.33 |
| **L.S.D. at 5%** | | 0.5 | 0.3 | 0.3 | 0.3 | 0.5 | n.s | 0.4 | n.s | 1.1 | 0.3 | 0.28 | 0.34 | 0.08 | 0.08 |

**Table 4:** Effect of interaction between cultivars x bio-fertilizer on growth characters of barely at 85 and 100 days after sowing. (Average of 2015/2016 and 2016/2017 seasons).

| Characters | | Plant height (cm) | | No. of tillers ($m^2$) | | No. of spikes ($m^2$) | | Spikes dry weight ($g/m^2$) | | Total dry weight ($g/m^2$) | | LA ($dm^2$) | | LAI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** |
| **Cultivars x Bio- fertilizer** | | | | | | | | | | | | | | | |
| **Giza- 128** | **Azoto.** | 87.9 | 97.7 | 444.9 | 448.9 | 439.4 | 443.8 | 658.3 | 754.2 | 1199.6 | 1255.7 | 31.95 | 34.32 | 2.93 | 3.11 |
| | **Yeast** | 90.9 | 100.8 | 447.8 | 451.3 | 443.2 | 447.5 | 665.5 | 758.7 | 1208.9 | 1263.9 | 33.33 | 35.94 | 3.01 | 3.31 |
| **Giza- 129** | **Azoto.** | 85.5 | 93.8 | 441.0 | 445.0 | 436.8 | 441.2 | 655.3 | 750.1 | 1190.8 | 1244.6 | 30.16 | 32.05 | 2.78 | 2.80 |
| | **Yeast** | 87.9 | 97.4 | 445.1 | 449.0 | 437.9 | 443.4 | 657.8 | 754.1 | 1201.6 | 1256.4 | 32.21 | 34.26 | 2.93 | 3.13 |
| **L.S.D. at 5%** | | n.s | 0.3 | 0.5 | 0.2 | 0.3 | 0.4 | 0.3 | 0.3 | 0.9 | 0.3 | 0.12 | 0.25 | 0.04 | 0.07 |

**Table 5:** Effect of interaction between nitrogen fertilizer x bio-fertilizer on growth characters of barely at 85 and 100 days after sowing. (Average of 2015/2016 and 2016/2017 seasons).

| Characters | | Plant height (cm) | | No. of tillers ($m^{2)}$ | | No. of spikes ($m^2$) | | Spikes dry weight ($g/m^2$) | | Total dry weight ($g/m^2$) | | LA ($dm^2$) | | LAI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Treatments** | | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** | **85** | **100** |
| **Nitrogen fertilizer(Ammonia Gas) x Bio-fertilizer** | | | | | | | | | | | | | | | |
| **Control** | **Azoto.** | 82.5 | 90.8 | 436.9 | 440.8 | 431.4 | 436.7 | 644.2 | 742.5 | 1178.7 | 1233.6 | 27.87 | 30.11 | 2.50 | 2.61 |
| | **Yeast** | 84.3 | 93.3 | 439.5 | 443.0 | 433.9 | 438.8 | 649.0 | 745.8 | 1186.7 | 1240.6 | 29.62 | 31.23 | 2.65 | 2.87 |
| **25 kg N /fed.** | **Azoto.** | 85.3 | 94.4 | 440.5 | 444.8 | 436.3 | 440.2 | 654.9 | 747.3 | 1188.4 | 1243.3 | 29.84 | 32.29 | 2.74 | 2.86 |
| | **Yeast** | 87.5 | 97.2 | 444.2 | 448.6 | 437.0 | 443.5 | 658.9 | 751.6 | 1199.5 | 1256.3 | 31.98 | 33.99 | 2.91 | 3.12 |
| **50 kg N /fed.** | **Azoto.** | 88.0 | 97.4 | 445.4 | 448.9 | 440.7 | 444.6 | 661.3 | 756.0 | 1201.3 | 1255.5 | 32.07 | 34.09 | 2.96 | 3.08 |
| | **Yeast** | 91.2 | 101.2 | 449.2 | 452.4 | 443.7 | 447.8 | 666.4 | 761.3 | 1212.7 | 1265.7 | 33.51 | 36.70 | 3.03 | 3.37 |
| **75 kg N /fed.** | **Azoto.** | 91.1 | 100.6 | 449.1 | 453.3 | 444.0 | 448.5 | 666.9 | 762.9 | 1212.3 | 1268.0 | 34.45 | 36.25 | 3.23 | 3.28 |
| | **Yeast** | 94.5 | 104.5 | 452.7 | 456.8 | 447.6 | 451.6 | 672.4 | 767.0 | 1222.1 | 1278.1 | 35.96 | 38.50 | 3.29 | 3.53 |
| **L.S.D. at 5%** | | 0.6 | 0.4 | 0.7 | 0.3 | 0.5 | 0.6 | 0.5 | 0.4 | 1.2 | 0.4 | 0.17 | 0.36 | 0.05 | n.s |

**Table 6:** Effect of interaction between cultivars x nitrogen fertilizer x bio-fertilizer on growth characters of barely at 85 and 100 days after sowing. (Average of 2015/2016 and 2016/2017 seasons).

| Treatments | | Characters | Plant height (cm) | | No. of tillers ($m^{2)}$ | | No. of spikes ($m^2$) | | Spikes dry weight ($g/m^2$) | | Total dry weight ($g/m^2$) | | LA ($dm^2$) | | LAI | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 85 | 100 | 85 | 100 | 85 | 100 | 85 | 100 | 85 | 100 | 85 | 100 | 85 | 100 |
| **Cultivars x Nitrogen fertilizer(Ammonia Gas) x bio-fertilizer** | | | | | | | | | | | | | | | | |
| Giza- 128 | Cont. | Azoto. | 83.1 | 91.9 | 438.8 | 442.0 | 432.2 | 437.7 | 642.8 | 743.8 | 1182.9 | 1236.1 | 28.23 | 31.58 | 2.55 | 2.78 |
| | | Yeast | 85.8 | 94.9 | 441.8 | 445.2 | 436.4 | 441.1 | 655.3 | 748.8 | 1192.2 | 1248.2 | 29.79 | 31.34 | 2.61 | 2.86 |
| | 25 kg N/fed. | Azoto. | 86.5 | 96.0 | 442.1 | 446.8 | 438.0 | 441.3 | 658.0 | 748.8 | 1191.1 | 1250.0 | 30.49 | 33.32 | 2.73 | 3.07 |
| | | Yeast | 88.8 | 98.9 | 445.6 | 449.5 | 440.7 | 446.0 | 661.0 | 754.1 | 1204.5 | 1259.4 | 32.75 | 35.32 | 2.98 | 3.25 |
| | 50 kg N /fed. | Azoto. | 89.3 | 99.6 | 447.8 | 450.9 | 441.7 | 446.5 | 663.0 | 759.2 | 1208.1 | 1261.1 | 33.32 | 35.66 | 3.11 | 3.28 |
| | | Yeast | 92.8 | 102.8 | 450.0 | 453.1 | 446.0 | 449.2 | 669.8 | 762.7 | 1214.3 | 1267.2 | 34.23 | 37.78 | 3.13 | 3.50 |
| | 75 kg N /fed. | Azoto. | 92.8 | 103.4 | 450.9 | 455.8 | 445.7 | 449.7 | 669.6 | 765.1 | 1216.2 | 1275.4 | 35.76 | 36.73 | 3.33 | 3.33 |
| | | Yeast | 96.1 | 106.4 | 453.7 | 457.6 | 449.5 | 453.5 | 676.1 | 769.3 | 1224.7 | 1280.9 | 36.53 | 39.33 | 3.33 | 3.63 |
| Giza- 129 | Cont. | Azoto. | 81.9 | 89.6 | 435.0 | 439.7 | 430.6 | 435.8 | 645.6 | 741.2 | 1174.5 | 1231.1 | 27.50 | 28.64 | 2.46 | 2.44 |
| | | Yeast | 82.8 | 91.7 | 437.2 | 440.8 | 431.3 | 436.6 | 642.8 | 742.8 | 1181.3 | 1233.0 | 29.44 | 31.13 | 2.69 | 2.87 |
| | 25 kg N /fed. | Azoto. | 84.2 | 92.8 | 438.9 | 442.7 | 434.5 | 439.0 | 651.9 | 745.8 | 1185.8 | 1236.7 | 29.19 | 31.25 | 2.74 | 2.64 |
| | | Yeast | 86.2 | 95.6 | 442.8 | 447.8 | 433.2 | 441.1 | 656.7 | 749.1 | 1194.5 | 1253.2 | 31.20 | 32.65 | 2.84 | 2.98 |
| | 50 kg N/fed. | Azoto. | 86.7 | 95.2 | 443.0 | 446.9 | 439.8 | 442.7 | 659.6 | 752.7 | 1194.6 | 1249.9 | 30.82 | 32.52 | 2.80 | 2.88 |
| | | Yeast | 89.5 | 99.6 | 448.4 | 451.7 | 441.3 | 446.4 | 663.0 | 759.9 | 1211.1 | 1264.3 | 32.79 | 35.61 | 2.94 | 3.25 |
| | 75 kg N/fed. | Azoto. | 89.3 | 97.7 | 447.2 | 450.8 | 442.2 | 447.4 | 664.2 | 760.6 | 1208.4 | 1260.6 | 33.13 | 35.77 | 3.12 | 3.24 |
| | | Yeast | 92.9 | 102.6 | 451.8 | 455.9 | 445.7 | 449.7 | 668.7 | 764.7 | 1219.6 | 1275.3 | 35.40 | 37.67 | 3.24 | 3.43 |
| L.S.D. at 5% | | | n.s | 0.5 | 1.0 | 0.4 | 0.7 | 0.8 | 0.7 | 0.6 | 1.8 | 0.6 | 0.24 | 0.51 | 0.07 | 0.14 |

**Effect of interaction between barley cultivars x nitrogen fertilizer x bio-fertilizer:**

Data in Table (6) showed that the interaction between barley cultivars x nitrogen fertilizer x bio-fertilizer was significant in all growth characters under study at 85 and 100 days from sowing except plant height (cm) at 85 days from sowing. It is clear from data in table (6) that the best value for growth characters at 85 and 100 days from sowing i.e. (plant height at 100 days from sowing only, number of tillers/ $m^2$, number of spikes/ $m^2$, spikes dry weight ($g/m^2$), total dry weight ($g/m^2$), leaf area ($dm^2$) and leaf area index) were obtained by planting Giza- 128 cultivar + 75 kg N/feddan ammonia gas 82 % + Yeast inoculation.

## References

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