*J. Agric. Sci. Mansoura Univ., 32 (3): 1671 - 1690, 2007*

# EFFECT OF SOME AGRICULTURAL TREATMENTS ON BARLEY YIELD AND SOME TECHNOLOGICAL CHARACTERS

**El-Sheref, E. El. M.[1]; A.M.Omar[1]; A.A. El-Hag[2] and Alaa M. Shahen[3]**
**1- Agron. Dept., Fac. Agric., Kafr El-Sheikh Univ.**
**2- Wheat Dept., Field Crops Res. Inst., Agric. Res. Center**
**3- Seed Technology, Field Crops Res. Inst., Agric. Res. Center**

## ABSTRACT

Two field experiments were carried out at Sakha Agricultural Research Station, during 2001/02 and 2002/03 seasons to investigate the response of four barley cultivars (Giza 123, Giza 126, Giza 2000 and line 2) to moisture stress at different growth stages (one irrigation was applied at sowing; two irrigations were applied, the first at sowing and the second after 45 days from sowing and three irrigations were applied at sowing, after 45 days and 75 days from sowing) and three nitrogen levels (0, 18 and 35 kg N/fed.). The experimental design was a split-split plot, where the irrigation treatments were allocated to the main plots and nitrogen levels arranged to the sub plots, while the four cultivars occupied the sub-sub plots.

The results showed that increasing number of irrigation significantly increased grain yield and its components and also the traits under this investigation. Increasing nitrogen level from 0 to 35 kg N/fed. led to significant increases in all studied traits except in case of grain ash percentage, grain moisture content and relative density of grain barley. The results also showed that Giza 123 had the highest values of grain yield, yield components and all grain quality traits under this studies. It could be concluded that cultivation of Giza 123 under 35 kg N/fed. combined with two or three irrigations gave the best agronomic and quality traits.

## INTRODUCTION

Barley is the main cereal crop grow along the West Northern coast of Egypt under rainfed conditions, and in the newly reclaimed lands and the old ones. Barley has been recognized as an adapted crop to adverse conditions as heat, salinity, drought and poor soils. It could survive and grow satisfactory under such conditions than several other crops.

The most use of barley is for animal feeding and breweries industry. However, there is an interest in using it as human food in regions where other cereals cannot grow well due to latitude, low rainfall, or soil salinity. In addition to grain uses, straw is used for animal feeding and immature barley plants are harvested for granzing and also by cut for hay or silage. In Egypt, barley faces severe competition in the old valley with other winter crops; i.e., wheat, beet, food legumes and clover etc.

The water use and needs of barley are highly dependent upon the climate and the growth stage. Any water stress will reduced total dry matter production. Water stress at tillering and heading reduces seed number, and stress after heading can reduce seed size. Water stress just before, during and after floret fertilization is especially detrimental to yield, El-Ganbeehy (2001), Atta (2002), Saleem (2003).

Nitrogen fertilizer contributed greatly to improve grain yield. Although nitrogen fertilizer effects on barley production have been exclusively studied and further studies on determining the optimum nitrogen levels is still needed. Moreover, the importance of nitrogen source is still debatable. Approximately 1 kg of N is required for each 34 kg of grain production, Sobh *et al.* (2000), El-Hag (12001), Megahed and Mohammed (2001), Maqsood *et al.* (2002) and El-Shaarawy (2003).

A wide variation among barley cultivars in grain yield, yield components and quality were reported by many investigators; Saleh (2000), Mustafa (2002) and Soad *et al.* (2004).

The main objective of the present investigation aims to increase barley production and its quality through the physiological response of four barley cultivars to moisture stress under different nitrogen fertilizer levels.

## MATERIALS AND METHODS

Two field experiments were conduced in 2001/2002 and 2002/2003 growing seasons at Sakha Agricultural Research Station, Agricultural Research Center, Egypt, to study the effect of number of irrigations and nitrogen fertilization levels on growth, yield and its components as well as grain quality of four barley cultivars. The preceding crop was cotton in the first season and maize in the second one.

Phosphorus was added as super phosphate 15.5% $P_2O_5$ (15 kg $P_2O_5$)/fed.) during land preparation. Barley was sown on 29$^{th}$ and 14$^{th}$ of December in the two seasons, respectively. Soil samples were taken from the experimental sites from the top to 30 cm (mean of two seasons). Mechanical analysis it's (Sand 16.3% clay 47.90 and Silt 36.50%), while, chemical analysis it's [pH 8.5, Organic matter 2.20%, EC 2.95 and Available N, P and K (ppm) 30.50, 8.2 and 246.5, respectively].

The experimental design was split split plot with three replications. Three irrigations treatments were assigned to main plots, only one irrigation was applied at sowing, two irrigations were applied, the first at sowing and the second at 45 days after sowing and three irrigations were applied at sowing, 45 days and 75 days after sowing. The three nitrogen levels (0, 18 and 35 kg N/fed.) were distributed in the sub plots. Nitrogen fertilizer was applied in the form of ammonium nitrate (33.5% N) and adding at sowing while the four barley cultivars (Giza 123, Giza 126, Giza 2000 and line 2) Occupied the sub sub plots. The experimental unit was 3.6 m$^2$ which included 6 rows (3 m in long and 20 cm apart). The central four rows were used to determine yield and yield attributes.

The studied characters were; heading dates, leaf area (dm$^2$), dry matter accumulation, crop growth rate, relative growth rate, net assimilation rate: plant height (cm), number of spikes per squares meter, spike length (cm); number of grains/spike, 1000 grain weight (gm), biological yield (ton/fed.), grain yield (ardab/fed.) straw yield (ton/fed.), harvest index %, grain protein percentage (%), grain ash percentage (%), moisture content , relative density, standard germination percent.

All the data collected were subjected to statistical analysis of variance as described by Snedecor and Cochran (1967). The mean values were compared according to Duncan's Multiple Range Test (Duncan, 1955). Also, percentage data were transformed to Arcsine before statistical analysis, and the means were presented before transformed in scale.

**Table (1): Date of irrigation commencing sowing date, it's volume for different irrigation treatments, effective rainfall and seasonal water applied in the two seasons.**

| Water resource | Irrigation treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 2001/02 | | | | 2002/03 | | | |
| | Dates | Singe | Two | Three | Dates | Singe | Two | Three |
| Irrigation water | 29/12/2001 | 430 | 430 | 430 | 14/12/2002 | 410 | 410 | 410 |
| | 12/2/2002 | 0.0 | 360 | 360 | 27/1/2003 | 0.0 | 340 | 340 |
| | 14/3/2002 | 0.0 | 0.0 | 510 | 1/3/2003 | 0.0 | 0.0 | 4180 |
| Sum | | 430 | 790 | 1300 | | 410 | 750 | 1230 |
| Effective rainfall ($m^3$/fed.) | | 208 | 208 | 208 | | 450 | 450 | 450 |
| Seasonal irrigation water | | 638 | 998 | 1508 | | 860 | 1200 | 1680 |

## RESULTS AND DISCUSSION

### A. Growth analysis and attributes:

### A.1. Number of days to heading:

Concerning the effect of number of irrigations on number of days to 50% heading, data presented in Table (2) revealed that the differences in this trait were insignificant and highly significant in 2001/02 and 2002/03 respectively. In general, increasing number of irrigations led to the increase in number of days to 50% heading. Referring to increasing the soil moisture the availability of nutrients increased, thus encouraged the initiation of more tillers and elongates vegetative growth period and hence delayed heading date. Similar results were obtained by Gharti and Lales (1988).

Regarding to the effect of N rates on number of days to 50% heading the data show significant effect on this criterion in both seasons. In general, increasing nitrogen levels up to 35 kg N/fed. increased the vegetative growth period and hence, delayed heading date compared to the control. Table-2. These results are in harmony with those of Amer (1999), El-Hag (2001) and Soad *et al.* (2004).

There were highly significant difference among barley cultivars in number days to 50% heading. Barley cultivar Giza 126 and Line 2 recorded the highest number of days to heading. Similar results have been recorded by Afifi (1999) and Soad *et al.* (2004).

Interactions between (number of irrigation x N rates, irrigation x cultivars and N-rates x cultivars) were significant for this trait in the 2002/03 growing season only.

### A.2. Plant height (cm):

The results presented in Table (2), revealed that plant height was significantly affected by the number of irrigation in the two seasons. The results indicated that the longest plants were recorded with two and three irrigations treatments in both seasons. These results may be due to the effect of more water availability, nutrients, which was reflected with more cell division and internodes elongation. The obtained results are in harmony with those recorded by El-Ganbeehy (2001), El-Banna *et al.* (2002) and Saleem (2003).

**Table (2): Days to heading and plant height of barley cultivars as affected by irrigation number and nitrogen fertilizer rates in 2001/02 and 2002/03 seasons.**

| Treatments | Days to heading | | Plant height (cm) | |
|---|---|---|---|---|
| | 2001/02 | 2002/03 | 2001/02 | 2002/03 |
| **Number of irrigations (A):** | | | | |
| One irrigation | 82.36 | 85.92 b | 115.38 c | 111.98 c |
| Two irrigation | 82.42 | 84.19 c | 118.72 b | 115.32 b |
| Three irrigation | 82.78 | 86.58 a | 121.45 a | 118.05 a |
| Sig. | NS | ** | ** | ** |
| **Nitrogen rates (B):** | | | | |
| 0 kg N/fed. | 82.08 b | 83.55 c | 114.74 c | 111.34 c |
| 18 kg N/fed. | 82.22 b | 86.08 b | 118.83 b | 115.43 b |
| 35 kg N/fed. | 83.25 a | 87.05 a | 121.98 a | 118.58 a |
| Sig. | * | * | * | * |
| **Cultivars (C):** | | | | |
| Giza 123 | 82.55 b | 85.51 ab | 120.28 a | 116.88 a |
| Giza 126 | 83.40 a | 85.37 b | 116.98 c | 113.58 c |
| Giza 2000 | 81.96 b | 85.33 b | 117.98 c | 114.58 c |
| Line 2 | 82.15 b | 86.03 a | 118.82 b | 115.42 b |
| **Sig.** | ** | ** | ** | ** |
| **Interactions:** | | | | |
| A x B | NS | * | ** | * |
| A x C | NS | ** | ** | ** |
| B x C | NS | * | ** | ** |
| A x B x C | NS | ** | ** | ** |

***, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.**
**Means designated by the same latter are not significantly different at the 5% level according to Duncan's Multiple Range Test (1955).**

Increasing nitrogen rate from 0 to 35 kg N/fed. led to significant increase in plant height in the two seasons. Plants fertilized with 35 kg N/fed. produced the highest values of this trait. El-Bawab (1990), El-Hag (2001), Soad *et al.* (2004) obtained similar results

The difference among cultivars in plant height was highly significant in both seasons. Obviously, Giza 123 had taller plants than the other cultivars. the results are in a good accordance with those obtained by Afifi (1999), Tarrad *et al.* (2002) and El-Hag (2001). The interaction effect between all factors were significant for this trait in both season.

**A.3. Leaf area ($dm^2$):**

Results of leaf area (Table 3) show that highly significant difference existed among the irrigation number in 2001/02 and significance different in 2002/03 season at four growth stages. In general, increased number of irrigations increased leaf area. These results are similar to those reported by Saadia *et al.* (1993).

Nitrogen had highly significant promotional effects on this trait. The highest values were obtained with 35 kg N/fed. and the lowest one was obtained with the check treatment (0 kg N/fed.) in both seasons. These results are in harmony with these of Sorour *et al.* (1998).

Results of leaf area show that highly significant difference existed among the four cultivars in both seasons at the four growth stages. Giza 126 and line 2 recorded the highest values in the first season at the four growth stages, while Giza 2000 recorded the highest mean values in the second season. Such findings are probably due to the difference in genetic background of the four cultivars. These results are similar to those reported by Gomez-Macpherson *et al.* (1998 a & b). Non of the interactions was significant in both seasons.

**A.4. Dry matter accumulation:**

Means of dry matter accumulation as affected by the number of irrigations, nitrogen fertilizer levels, cultivars and their interactions at four successive growth stages in 2001/02 and 2002/03 seasons are presented in Table (4).

The data indicated that the differences among number of irrigations for dry matter accumulation at different stages were highly significant in the first season, while it was significant in the second season as pointed out in Table (4). In general, increasing number of irrigations increased dry matter accumulation. Such finding may be attributed to the increase of plant height, stems, leaf area and spike weight percentage. These results are in harmony with those of Tarrad *et al.* (2002).

Also, the results show that nitrogen fertilizer levels had highly significant effect on dry matter accumulation in the first season only. In general, increasing nitrogen fertilizer levels increased dry matter accumulation in the first season only. The increase in dry matter accumulation by increasing nitrogen fertilizer rates may be due to the increases in plant height, leaf area, spike weight and number of tillers resulting from the role of nitrogen in encouraging the photosynthetic metabolites. Similar results were obtained by Giorgio *et al.* (1992) and Latiri *et al.* (1998).

Concerning, the barley cultivars, data indicate significant differences among cultivars in dry matter accumulation in the first season only, while these differences were not significant in the second season at all growth stages. These results are similar to those reported by Gomez-Macpherson *et al.* (1998 a & b). Non of the interaction between the above mentioned three factors gave significant effect on dry matter accumulation in both seasons.

**A.5. Crop growth rate (CGR):**

Tables (5 & 6) show highly significant differences in CGR value due to number of irrigations at the second and third growth intervals in the first season and second growth interval in the second season. In general, three irrigations treatment recorded the highest values of CGR.

The effect of nitrogen levels on CGR gave highly significant difference in the first season at the second and third growth interval only. Generally, increasing nitrogen fertilizer levels from 0 to 35 kg N/fed. increased the values of CGR. The highest values were recorded at 35 kg N/fed. in both seasons.

In the first season, the values of CGR at the second and third growth interval for line 2 significantly exceeded other cultivars. Non of the interactions was significant in both seasons.

**Table (3): Means of leaf area at four sampling dates of barley cultivars as affected by irrigation regimes and nitrogen levels in 2001/02 and 2002/03 growing seasons.**

| | Irrigation number | | | | Nitrogen fertilizer levels (kg N/fed.) | | | | Cultivars | | | | | Interactions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sig. | One | Two | Three | Sig. | 0 | 18 | 35 | Sig. | Giza 123 | Giza 126 | Giza 2000 | Line 2 | IN | IV | NV | INV |
| | | | | | | | 2001/02 | | | | | | | | | | |
| 1st sample | ** | 4026.9 c | 4232.0 b | 4410.4 a | ** | 2647.4 c | 4791.5 b | 5230.4 a | ** | 3983.5 b | 4804.3 a | 3333.6 b | 4771.1 a | NS | NS | NS | NS |
| 2nd sample | ** | 4292.4 b | 4649.9 a | 4802.4 a | ** | 2973.4 c | 5158.8 b | 5612.1 a | ** | 4350.1 b | 5168.5 a | 3690.8 c | 5116.5 a | NS | NS | NS | NS |
| 3rd sample | ** | 4465.9 c | 4852.1 b | 5062.4 a | ** | 3208.3 c | 5358.3 b | 5813.8 a | ** | 456.26 b | 5368.1 a | 3913.5 c | 5329.6 a | NS | NS | NS | NS |
| 4th sample | ** | 4047.7 c | 4438.9 b | 4625.9 a | ** | 2786.4 c | 4949.6 b | 5376.6 a | ** | 4142.7 b | 4948.1 a | 3488.9 c | 4903.6 a | NS | NS | NS | NS |
| | | | | | | | 2002/03 | | | | | | | | | | |
| 1st sample | * | 3351.4 b | 3575.3 ab | 3807.4 a | ** | 3279.4 c | 3500.3 b | 3954.3 a | ** | 3677.3 c | 2603.7 d | 4289.8 a | 3741.3 b | NS | NS | NS | NS |
| 2nd sample | * | 3634.3 b | 3879.9 ab | 4124.8 a | ** | 3578.6 c | 3791.3 b | 4269.1 a | ** | 3999.4 b | 2893.1 c | 4591.1 a | 4035.2 b | NS | NS | NS | NS |
| 3rd sample | * | 4039.2 b | 4304.4 ab | 4572.8 a | ** | 3995.5 c | 4226.9 b | 4693.9 a | ** | 4408.5 c | 3322.3 d | 5019.4 a | 4471.6 b | NS | NS | NS | NS |
| 4th sample | * | 3714.1 b | 3952.9 ab | 4184.2 a | ** | 3656.3 c | 3869.1 b | 4325.8 a | ** | 4048.0 c | 2968.8 d | 4666.6 a | 4118.2 b | NS | NS | NS | NS |

*, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.

Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

**Table (4): Means of dry matter accumulation (gm) at four sampling dates of barley cultivars as affected by irrigation regimes and nitrogen levels in 2001/02 and 2002/03 growing seasons.**

| | Irrigation number | | | | Nitrogen fertilizer levels (kg N/fed.) | | | | Cultivars | | | | | Interactions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sig. | One | Two | Three | Sig. | 0 | 18 | 35 | Sig. | Giza 123 | Giza 126 | Giza 2000 | Line 2 | IN | IV | NV | INV |
| | | | | | | | 2001/02 | | | | | | | | | | |
| 1st sample | ** | 202.3 b | 211.2 ab | 218.5 a | ** | 204.6 c | 209.9 b | 217.6 a | ** | 196.1 c | 130.1 d | 207.9 b | 308.8 a | NS | NS | NS | NS |
| 2nd sample | ** | 423.4 b | 440.7 ab | 446.9 a | ** | 426.6 b | 435.7 b | 495.8 a | ** | 424.9 b | 354.9 c | 433.4 b | 535.3 a | NS | NS | NS | NS |
| 3rd sample | ** | 781.5 c | 893.6 b | 938.9 a | ** | 850.8 c | 877.3 b | 885.8 a | ** | 857.3 c | 779.9 d | 866.2 b | 981.9 a | NS | NS | NS | NS |
| 4th sample | ** | 970.3 c | 1055.1 b | 1095.3 a | * | 1026.8 b | 1046.8 a | 1047.2 a | ** | 1027.6 c | 948.8 d | 1036.1 b | 1148.7 a | NS | NS | NS | NS |
| | | | | | | | 2002/03 | | | | | | | | | | |
| 1st sample | * | 203.3 b | 220.9 ab | 241.2 a | NS | 218.9 | 222.0 | 224.9 | NS | 221.5 | 222.4 | 220.8 | 224.2 | NS | NS | NS | NS |
| 2nd sample | * | 444.9 b | 460.3 ab | 475.2 a | NS | 456.8 | 460.5 | 463.1 | NS | 459.6 | 460.4 | 457.9 | 462.6 | NS | NS | NS | NS |
| 3rd sample | * | 800.5 b | 821.9 ab | 840.1 a | NS | 815.9 | 821.8 | 824.8 | NS | 820.1 | 818.7 | 820.8 | 823.8 | NS | NS | NS | NS |
| 4th sample | * | 994.4 b | 1008.7 ab | 1025.9 a | NS | 1006.3 | 1009.7 | 1013.1 | NS | 1009.8 | 1008.8 | 1009.6 | 1010.6 | NS | NS | NS | NS |

*, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.

Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

Table (5): Means of crop growth rat (CGR), (g/m²/week) relative growth rate (RGR) (g/g/week) and net assimilation rate (NAR) (g/m²/week) at four sampling dates of barley barely cultivars as affected by irrigation numbers, nitrogen levels and their interaction at three growth intervals in 2001/02.

| | Irrigation number | | | | Nitrogen fertilizer levels (kg N/fed.) | | | | Cultivars | | | | | Interactions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sig. | One | Two | Three | Sig. | 0 | 18 | 35 | Sig. | Giza 123 | Giza 126 | Giza 2000 | Line 2 | IN | IV | NV | INV |
| | | | | | | | | | CGR | | | | | | | | |
| 1st sample | NS | 14.74 | 15.30 | 15.22 | Ns | 15.00 | 15.05 | 15.21 | NS | 15.25 | 14.97 | 15.03 | 15.10 | NS | NS | NS | NS |
| 2nd sample | ** | 23.87 c | 30.19 b | 32.80 a | ** | 28.08 b | 29.44 a | 29.34 a | ** | 28.83 b | 28.35 b | 28.86 b | 29.78 a | NS | NS | NS | NS |
| 3rd sample | ** | 10.43 c | 10.77 b | 12.59 a | ** | 10.76 c | 11.30 b | 11.73 a | ** | 11.12 d | 11.26 c | 11.32 b | 11.25 a | NS | NS | NS | NS |
| | | | | | | | | | RGR | | | | | | | | |
| 1st sample | NS | 0.022 | 0.002 | 0.023 | NS | 0.022 | 0.022 | 0.023 | Ns | 0.022 | 0.023 | 0.21 | 0.020 | NS | NS | NS | NS |
| 2nd sample | NS | 0.018 | 0.21 | 0.022 | NS | 0.022 | 0.020 | 0.20 | NS | 0.020 | 0.023 | 0.20 | 0.18 | NS | NS | NS | NS |
| 3rd sample | NS | 0.005 | 0.005 | 0.006 | NS | 0.005 | 0.005 | 0.006 | NS | 0.055 | 0.066 | 0.005 | 0.005 | NS | NS | NS | NS |
| | | | | | | | | | NAR | | | | | | | | |
| 1st sample | * | 0.359 b | 0.382 a | 0.397 a | ** | 0.283 c | 0.308 b | 0.547 a | ** | 0.428 a | 0.353 b | 0.426 a | 0.310 c | NS | NS | NS | NS |
| 2nd sample | ** | 0.594 b | 0.678 a | 0.712 a | ** | 0.516 b | 0.564 b | 0.905 a | ** | 0.717 a | 0.604 b | 0.746 a | 0.579 b | NS | NS | NS | NS |
| 3rd sample | NS | 0.015 | 0.017 | 0.019 | NS | 0.014 | 0.018 | 0.020 | NS | 0.017 | 0.019 | 0.015 | 0.018 | NS | NS | NS | NS |

*, ** and NS indicate $P < 0.05$, $P < 0.01$ and not significant, respectively.

Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

Table (6): Means of crop growth rat (CGR), (g/m²/week) relative growth rate (RGR) (g/g/week) and net assimilation rate (NAR) (g/m²/week) at four sampling dates of barley cultivars as affected by irrigation numbers, nitrogen levels and their interaction at three growth intervals in 2002/03.

| | Irrigation number | | | | Nitrogen fertilizer levels (kg N/fed.) | | | | Cultivars | | | | | Interactions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sig. | One | Two | Three | Sig. | 0 | 18 | 35 | Sig. | Giza 123 | Giza 126 | Giza 2000 | Line 2 | IN | IV | NV | INV |
| | | | | | | | | | CGR | | | | | | | | |
| 1st sample | * | 16.11 b | 15.54 a | 15.95 a | NS | 15.86 | 15.87 | 15.86 | NS | 15.88 | 15.87 | 15.84 | 15.90 | NS | NS | NS | NS |
| 2nd sample | * | 23.71 b | 24.11 a | 24.32 a | NS | 23.94 | 24.09 | 23.94 | NS | 24.03 | 23.88 | 24.19 | 24.08 | NS | NS | NS | NS |
| 3rd sample | NS | 12.43 | 12.48 | 12.94 | NS | 12.51 | 12.56 | 12.51 | NS | 12.63 | 12.78 | 12.52 | 12.53 | NS | NS | NS | NS |
| | | | | | | | | | RGR | | | | | | | | |
| 1st sample | NS | 0.020 | 0.021 | 0.023 | NS | 0.021 | 0.021 | 0.021 | NS | 0.021 | 0.021 | 0.021 | 0.021 | NS | NS | NS | NS |
| 2nd sample | NS | 0.016 | 0.017 | 0.017 | NS | 0.017 | 0.017 | 0.017 | NS | 0.017 | 0.017 | 0.017 | 0.017 | NS | NS | NS | NS |
| 3rd sample | NS | 0.006 | 0.006 | 0.006 | NS | 0.006 | 0.006 | 0.006 | NS | 0.006 | 0.006 | 0.006 | 0.006 | NS | NS | NS | NS |
| | | | | | | | | | NAR | | | | | | | | |
| 1st sample | ** | 0.347 b | 0.370 ab | 0.385 a | ** | 0.271 c | 0.296 b | 0.535 a | ** | 0.416 a | 0.341 b | 0.414 a | 0.298 c | NS | NS | NS | NS |
| 2nd sample | ** | 0.480 b | 0.564 a | 0.598 a | ** | 0.402 c | 0.450 b | 0.791 a | ** | 0.632 a | 0.490 c | 0.603 a | 0.465 b | NS | NS | NS | NS |
| 3rd sample | NS | 0.009 | 0.10 | 0.012 | NS | 0.007 | 0.011 | 0.013 | NS | 0.010 | 0.012 | 0.008 | 0.10 | NS | NS | NS | NS |

*, ** and NS indicatP $< 0.05$, $P < 0.01$ and not significant, respectively.

Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

**A.6. Relative growth rate (RGR):**

Results of RGR show no significant different among all factors tested in this study in both seasons (Tables 5 and 6).

**A.7. Net assimilation rate (NAR):**

Increasing irrigation numbers significantly increased NAR in both seasons at the first and second intervals only. The increase in NAR may be due to the increase in leaf area and dry matter accumulation in both seasons at all sampling dates (Tables 5 and 6).

The same tend was true in the case of nitrogen rates, increasing nitrogen levels increased NAR.

Results of NAR show that highly significant difference existed among four cultivars at the first and second growth intervals in both seasons, where Giza 123 recorded the highest value in the first and second seasons. Non of the interaction was significant in both seasons.

**B. Yield and yield components:**

**B.1. Number of spikes/m$^2$:**

Refereeing to the influence of number of irrigations on this trait, the data clearly show that this attribute was highly significant affected by the number of irrigations in both seasons (Table 7). Three irrigations treatment recorded the highest number of spike/m$^2$ (678.81 and 674.44) and the lowest number of spies/m$^2$ was obtained (483.91 and 626.80) with one irrigation. It is clear that exposing barley plant to drought stress reduced the number of spikes/m$^2$. Such response may be attributed to lack of water absorbed and reduction in photosynthetic efficiency under insufficient water condition. Moreover, the reduction in assimilates was translocated to new developing tillers might owe much to the death of the new tillers and depressed the number of spikes primordial El-Ganbeehy (2001) and El-Banna *et al.* (2002) came to similar conclusion.

With respect to nitrogen fertilizer effect, data in Table (7) elucidate that variation in nitrogen rates caused positive significant different number of spikes/m$^2$ in both seasons. Increasing rates from 0 to 35 kg N/fed. led to significant remarkable increase in number of spikes/m$^2$. This increase may be due to the fact that N is an essential element which plays essential role in building new meristemic cells, cell elongation and increasing photosynthesis activity, which in turn enhances spikes. Similar results were obtained by Toaima *et al.* (2000), Megahed and Mohammed (2001) and Farag (2003).

Data in Table (7) show that , Giza 123 had more spikes/m$^2$ than the other cultivars, while Giza 126 and Giza 2000 produced the lowest value in both seasons. Our results came in accordance with those obtained by several reporters Ghanem and Gomaa (1985), El-Hag (2001) and Soad *et al.* (2004). For interactions effect. The highest number of spikes/m$^2$ was recorded with three irrigations and 35 kg N/fed., as Giza 126 gave the highest number of spikes/m$^2$ with three irrigations and 35 kg N/fed. in the second season.

**B.2. Spike length:**

Table (7) indicate that moisture regime treatments had a significant effect on spike length in both seasons.

Table (7): Mean values of number of spikes/m$^2$, spike length (cm), number of grain/spike and 1000-grain weight of barley cultivars as affected by number of irrigation, nitrogen fertilizer levels and their interactions in 2001/02 and 2002/03 seasons.

| Treatment | No. of spike/m$^2$ | | Spike length (cm) | | No. of grain/spike | | 1000-grain weight | |
|---|---|---|---|---|---|---|---|---|
| | 2001/02 | 2002/03 | 2001/02 | 2002/03 | 2001/02 | 2002/03 | 2001/02 | 2002/03 |
| **Number of irrigation (A):** | | | | | | | | |
| One irrigation | 483.91 c | 626.82 c | 8.83 c | 8.43 c | 67.57 c | 65.42 c | 50.71 c | 49.41 c |
| Two irrigation | 548.52 b | 651.21 b | 9.03 b | 8.63 b | 69.67 b | 67.52 b | 52.23 b | 50.83 b |
| Three irrigation | 678.81 a | 674.44 a | 9.28 a | 8.88 a | 71.37 a | 69.22 a | 53.81 a | 52.61 a |
| Sig. | ** | ** | ** | ** | ** | ** | * | ** |
| **Nitrogen rates (B):** | | | | | | | | |
| 0 kg/fed. | 530.13 b | 632.49 c | 8.82 c | 8.42 c | 67.78 c | 65.63 c | 51.41 | 50.11 |
| 18 kg/fed. | 591.98 a | 651.41 b | 9.11 b | 8.71 b | 69.98 b | 67.83 b | 51.88 | 50.80 |
| 35 kg/fed. | 583.11 a | 668.62 a | 9.20 a | 8.1 a | 70.85 a | 68.70 a | 52.82 | 51.53 |
| Sig. | ** | ** | ** | ** | ** | ** | NS | NS |
| **Cultivars (C):** | | | | | | | | |
| Giza 123 | 617.83 a | 708.32 a | 8.86 d | 8.46 d | 71.84 a | 69.69 a | 53.42 b | 52.11 b |
| Gia 126 | 546.80 c | 593.71 c | 8.93 c | 8.53 c | 71.18 b | 69.03 b | 51.21 c | 49.83 c |
| Gia 2000 | 546.31 c | 606.41 c | 9.37 a | 8.97 a | 63.87 c | 61.72 c | 55.73 a | 54.43 a |
| Line 2 | 570.31 b | 694.83 b | 9.03 b | 8.63 b | 71.25 b | 69.10 b | 48.81 d | 47.52 d |
| Sig. | ** | ** | ** | ** | ** | ** | ** | * |
| **Interactions:** | | | | | | | | |
| A x B | NS | ** | ** | ** | ** | ** | NS | NS |
| A x C | NS | ** | ** | ** | ** | ** | NS | NS |
| B x C | NS | ** | ** | ** | ** | * | NS | * |
| A x B x C | NS | ** | ** | ** | ** | NS | NS | NS |

*, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.
Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

The highest values of spike length (9.28 and 8.88 cm) were obtained by three irrigation, while the lowest value (8.83 and 8.43 cm) were recorded by one irrigation in the two seasons, respectively. These results are in agreement with those reported by Tarrad *et al.* (2002).

Data in Table (7) indicate that significant difference was observed due to the increase in nitrogen fertilizer level. It is clear that there was a gradual increase as nitrogen levels increased up to 35 kg N/fed. These results supported the findings of El-Hag (2001), Farag (2003) and Soad *et al.* (2004).

The difference among cultivars in spike length was significant in the two seasons Table (7). It is clear that Giza 2000 gave the highest value of spike length over the others three cultivars in both seasons. Many workers, i.e. Afifi (1999), Saleh (2000) and El-Hag (2001) reported that variation in spike length between cultivars were found.

Data reported that highly significant interaction was observed among factors tested in this trait in both seasons.

**B.3. Number of grains/spike:**

It could be noticed that the exposure of plants to water shortage at any developmental growth stage decreased significantly number of grains/spike. These results are true in both seasons. The greatest reduction in number of grains/spike resulted from severe water stress in both seasons (only one irrigation at sowing date). This reduction in number of grains spike might be due to the reduction n number of irrigation ovules. Moreover, the reduction in photosynthetic efficiency and the lack of photsynthates translocated to the developing seeds by adding irrigation might owe much to these results. The results are supported with those obtained by Assey *et al.* (1990) and El-Sayed (2003).

It is observed from the data that nitrogen fertilization rates gave highly significant effect on number of grains/spike in the two growing seasons. Increasing nitrogen rate from 0 to 35 kg N/fed. resulted in remarkable significant increase in this trait. The highest value of this trait were obtained with 35 kg N/fed. (70.85 and 698.70) and the lowest ones were produced with the control treatment (67.78 and 65.63). This trend hold true in both seasons, respectively. These results could be attributed to the role of nitrogen in spike fertility and grain development.

The differences among cultivars in number of grains/spike were highly significant in both seasons. Giza 123 recorded the highest numbers of grains/spike (71.84 and 69.69) in both seasons, respectively. Similar results have been reported by Saadia *et al.* (1983) and Afifi (1999).

For the interaction effect among the factors tested, data revealed that 35 kg N/fed. with three irrigations gave the highest number of grains per spike. Also, Giza 123 recorded the highest number of grains/spike with three irrigations and 35 kg N/fed.

**B.4. 1000-grain weight:**

Data in Table (7) show that 1000-grain weight was significant affected by number of irrigations added at the different growth stages. Generally, it could be noticed that missing an irrigation at any growth stage led to a reduction in 1000-grain weight. This reduction might be attributed to that water deficiency during the vegetative, flowering and grain filling stages, which reduce available assimilate for grain filling and retranslocation of stored assimilates to grains which in turn cause reduction in grain size. These results are confirmed by El-Ganbeehy (2001) and El-Sayed (2003).

With respect to the response of 1000-grain weight to nitrogen, results presented in Table (7) reveal that the differences among all nitrogen levels on 1000-grain weight did not reach the level of significance in the two growing seasons.

Regarding the differences among barley cultivars for 1000-grain weight at highly significant effect was obtained in both seasons. Giza 2000 outyielded the other cultivars which recorded (55.73 and 54.43 gm) in both seasons. These results are in harmony with those obtained by Afifi (1999), and El-Hag (2001).

For interaction data show that Giza 2000 with 18 or 35 kg N/fed. recorded the highest values of 1000-grain weight.

**B.5. Biological yield:**

Concerning the effect of number of irrigations on biological yield, data in Table (8) revealed that the differences in this trait were significant in both seasons. the results indicated that three irrigations recorded the highest values (6.20 and 6.44 t/fed.), while the one irrigation recorded the lowest yield (5.36 and 5.56 t/fed.) in the first and second seasons, respectively. These results agree with those of El-Ganbeehy (2001) and Tarrad (2002).

Regarding nitrogen rates, results show highly significant increases in biological yield in both seasons. In general, 35 kg N/fed. outyielded than other treatments and ranked the first (6.41 and 6.50 t/fed.) followed by 18 kg N/fed. (5.70 and 6.16 t/fed.), while the 0 kg N/fed. produce the lowest yield (5.25 and 5.36) in both seasons, respectively. The increases in biological yield by increasing nitrogen fertilization might be due to the same reasons that recorded before with the case of plant height, number of tiller/$m^2$ and grain weight per spike. These results are in good agreement with the findings of El-Hag (2001), Megahed and Mohammed (2001) and Farag (2003).

Results in Table (8) show that varieties exhibited a highly significant different in biological yield in both seasons. Giza 123 produce the highest values (6.11 and 6.44 t/fed.), while line 2 recorded the lowest yield (5.63 and 5.60 t/fed.) in both seasons, respectively. These results are in good agreement with the findings of Noaman *et al.* (1997) and El-Hag (2001).

Regarding the interaction among the factors tested, data show that the highest biological yield was obtained by applying three irrigations with 35 kg N/fed. and line 2.

**B.6. Grain yield:**

Concerning the response of grain yield to number of irrigations treatments, results presented in Table (8), indicate that exposure plants to water shortage at any one of the studied growth stages decreased significantly grain yield. The greatest reduction in grain yield was resulted from severe water stress in both seasons (one irrigation only). This reduction might be attributed not only to the reduction in number of spikes/$m^2$ but also to the reduction in number of grains/spike and spike length.

Table (8): Mean values of biological yield, grain yield, straw yield (ton/fed.) and harvest index of barley cultivars as affected by number of irrigation, nitrogen fertilizer levels and their interactions in 2001/02 and 2002/03 seasons.

| Treatment | Biological yield t/fed. | | Grain yield t/fed. | | Straw yield t/fed. | | Harvest index % | |
|---|---|---|---|---|---|---|---|---|
| | 2001/02 | 2002/03 | 2001/02 | 2002/03 | 2001/02 | 2002/03 | 2001/02 | 2002/03 |
| Number of irrigation (A): | | | | | | | | |
| One irrigation | 5.36 b | 5.56 c | 1.95 b | 2.26 b | 3.42 ab | 3.23 b | 36.21 b | 40.41 b |
| Two irrigation | 5.80 ab | 6.02 b | 2.29 b | 2.62 ab | 3.39 ab | 3.39 ab | 39.65 ab | 43.67 ab |
| Three irrigation | 6.20 a | 6.44 a | 2.68 a | 2.93 a | 3.51 a | 3.51 a | 45.21 a | 45.68 a |
| Sig. | ** | ** | ** | ** | ** | ** | * | ** |
| Nitrogen rates (B): | | | | | | | | |
| 0 kg/fed. | 5.25 c | 5.36 c | 2.08 c | 2.32 c | 3.18 b | 2.96 b | 39.81 b | 42.61 b |
| 18 kg/fed. | 5.70 b | 6.16 b | 2.29 b | 2.62 b | 3.41 b | 3.54 a | 40.23 b | 43.13 b |
| 35 kg/fed. | 6.41 a | 6.50 a | 2.54 a | 2.87 a | 3.87 a | 3.63 a | 41.12 a | 44.20 a |
| Sig. | ** | ** | ** | ** | ** | ** | * | ** |
| Cultivars (C): | | | | | | | | |
| Giza 123 | 6.11 a | 6.44 a | 2.55 a | 2.82 a | 3.71 a | 3.67 a | 41.73 a | 43.78 a |
| Gia 126 | 5.34 c | 6.12 b | 2.15 c | 2.53 b | 3.56 b | 3.49 b | 40.26 b | 41.33 b |
| Gia 2000 | 5.99 b | 6.17 b | 2.28 b | 2.50 b | 3.19 c | 3.62 a | 38.06 c | 40.51 c |
| Line 2 | 5.63 c | 5.60 c | 2.28 b | 2.30 c | 3.45 b | 3.20 c | 40.49 b | 41.07 b |
| Sig. | ** | ** | ** | ** | ** | ** | ** | ** |
| Interactions: | | | | | | | | |
| A x B | NS | ** | ** | ** | NS | NS | NS | NS |
| A x C | NS | NS | NS | NS | ** | NS | NS | NS |
| B x C | ** | * | ** | * | NS | ** | NS | NS |
| A x B x C | NS | NS | NS | NS | NS | NS | NS | NS |

*, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.

Means within the same raw for each factors designated by the same letter are not significantly different at 5% level according to Duncan's Multiple Range Test.

Grain yield was directly affected by the availability of soil water content in the effective root zone. Abundance of soil moisture resulted in healthy plants and consequently a higher yield could be obtained and vise versa regards the low availability of soil water (El-Bably, 1998, El-Ganbeehy, 2001, Atta, 2002, El-Sayed, 2003 and Abou Ahmed, 2004).

With respect to nitrogen levels effect, significant increases were obtained in grain yield in both seasons due to variation in nitrogen fertilizer levels. Data indicate clearly that, increasing nitrogen fertilizer from 0 to 18 and 35 kg N/fed. led to significant increases in grain yield (Table 8) in both seasons. The highest value of grain yield was obtained when barley plants were fertilized with 35 followed by 18 kg N/fed. The increase in grain yield/fed on account of increase in nitrogen levels from 0 to 35 kg N/fed. reached 21.01 and 22.11% in 2001/02 as well as 12.43 and 3.21% in 2002/03 season at the level of 18 and 35 kg N/fed. respectively, as compared to unfertilized treatment. These results are similar to those obtained by Birch *et al.* (1997), Said (1998), Amer (1999) and Saleh (2001).

The differences among cultivars in grain yield were highly significant in both seasons. It is obviously that Giza 123 was superior to the other cultivars in grain yield. Giza 123 produced highest grain yields (2.55 and 2.82 t/fed.) than the other cultivars, in both seasons, respectively. This might be attributed to the increase in number of spike/$m^2$, number of grains/spike and 1000-kernel weight. These results are in harmony with those recorded by El-Sayed *et al.* (1996), Abo El-Enin *et al.* (1998), Afifi (1999), El-Hag (2001) and Soad *et al.* (2004).

The interaction between number of irrigations and N-rates had significant effect on grain yield in both seasons Table (9). It could be observed that increasing both number of irrigations and nitrogen levels led to an increase in grain yield per feddan. The highest grain yield (2.85 and 3.09 t/fed.) were obtained by (three irrigations with 35 kg N/fed.). Also, the highest grain yields (2.61 and 3.03 t/fed.) were obtained when the plants of Line 2 were fertilized with 35 kg N/fed. (Table 10). Since, the maximum grain yield of barley resulted from using three irrigations and 35 kg N/fed. It might be recommended that the seasonal water requirements for barley crop, over both seasons, in the Delta amounted to an average 1594 $m^3$/fed. (El-Marsafawy, 1999). In other words, water duty of barley crop in Delta was about 1594 m3/fed. distributed as 79.3% irrigation water and 20.7% effective rainfall, over both seasons.

**Table (9): Mean values of grain yield (t/fed.) for barley cultivars as affected by number of irrigations and nitrogen fertilizer levels interaction in 2001/02 and 202/03 seasons.**

| Treatment | 2001/02 | | | 2002/03 | | |
|---|---|---|---|---|---|---|
| | One irrigation | Two irrigation | Three irrigation | One irrigation | Two irrigation | Three irrigation |
| 0 kg N/fed. | 1.67 g | 2.06 e | 2.50 c | 1.92 f | 2.32 e | 2.72 c |
| 18 kg N/fed. | 1.90 f | 2.52 c | 2.69 b | 2.27 e | 2.63 cd | 2.97 b |
| 35 kg N/fed. | 2.26 d | 2.52 c | 2.85 a | 2.59 d | 2.92 b | 3.09 a |
| Sig. | ** | | | ** | | |

## B.7. Straw yield:

Results in Table (8) show that significant difference exited between irrigation treatments for this trait in both seasons. Three irrigations gave heavier straw yield than one irrigation or two irrigations. These results are in harmony with those obtained by Atta (2002) and El-Sayed (2003).

Results in Table (8) show highly significant difference among nitrogen treatments in both seasons, where the N-rate at 35 kg N/fed. gave the highest straw yield. Increasing nitrogen caused more vigorous growth, high plant and tillers/m$^2$ values. These results are in good agreement with those of El-Hag (2001), El-Sharawy (2003) and Farag (2003).

**Table (10): Mean values of grain yield (t/fed.) for barley cultivars as affected by nitrogen fertilizer levels and cultivars interactions in 2001/02 and 2002/03 seasons.**

| Treatment | 2001/02 | | | 2002/03 | | |
|---|---|---|---|---|---|---|
| | 0 kg N/fed. | 18 kg N/fed. | 35 kg/N fed. | 0 kg N/fed. | 18 kg N/fed. | 35 kg/N fed. |
| Giza 123 | 2.09 g | 2.31 de | 2.56 ab | 2.20 f | 2.40 e | 2.71 c |
| Giza 126 | 1.91 h | 2.20 f | 2.53 ab | 2.21 f | 2.61 d | 2.78 c |
| Giza 2000 | 2.09 g | 2.27 ef | 4.47 bc | 2.32 e | 2.61 d | 2.96 ab |
| Line 2 | 2.22 ef | 2.40 cd | 2.61 a | 2.58 d | 2.88 b | 3.03 a |
| Sig. | ** | | | ** | | |

Concerning genotypes results show that Giza 123 outyielded the others cultivars in both seasons. No significant difference were obtained between Giza 126 and line 2 in the first seasons. These results are in harmony with the findings of Afifi (1999) and El-Hag (2001).

No significant interactions were obtained except between irrigation and cultivars in the first season and between nitrogen and cultivars in the second season.

## B.8. Harvest index:

Data in Table (8) show that moisture regimes, nitrogen rate and barley cultivars had significant effect on harvest index in both seasons. The highest harvest index values (45.21 and 45.68%) were obtained by three irrigation in both seasons, respectively. Also, the highest values of harvest index were obtained by applying 35 kg N/fed. (41.12 and 44.20%) in both seasons, respectively. Similar results were obtained by Maqsood *et al.* (2002). The highest harvest indexes were given by cv. Giza 123 (41.73 and 43.78%) in both seasons, respectively. No significant interaction was obtained for all factors studied.

## C. Some technological characters:

### C.1. Grain protein %:

Number of irrigations, N-rates and barely cultivars showed significant effect on protein percentage in the first season only (Table 11). The highest protein percentage was obtained by using three irrigations being (9.95%). Also, increasing nitrogen rates significantly increased protein percentage. The highest value (10.8%) was recorded with 35 kg N/fed. However, the cultivars Giza 123 and Giza 126 gave the highest protein percentages, where the values were (10.55 and 10.31%). Differences in protein % among cultivars could be attributed to genetic background of each cultivar and its interaction with the environmental condition especially nitrogen fertilization.

**C.2. Grain ash percentage:**

With regard to the effect of number of irrigations on ash percentage. Data show that this trait was highly significantly affected in both seasons. Three irrigations recorded the highest values (2.88 and 2.96%) in 2001/02 and 2002/03 seasons, respectively (Table 11).

No significant effect was obtained due to nitrogen fertilizer levels on ash percentage in both seasons.

The results show that significant difference existed among the four barley cultivars in both seasons. Giza 126 and Giza 2000 produced the highest values of ash percentage (Table 11).

The highest value of ash percentage was obtained from watering three times with 35 kg N/fed. (2.93%). Also, Giza 126 with three irrigation produced the highest ash percentage.

**Table (11): Mean values of protein, ash and moisture contents for barley cultivars as affected by number of irrigations, nitrogen fertilizer level and their interactions in 2001/02 and 2002/03 seasons.**

| Treatments | Protein percentage | | Ash | | Moisture content | |
|---|---|---|---|---|---|---|
| | 2001/02 | 2002/03 | 2001/02 | 2002/03 | 2001/02 | 2002/03 |
| **Number of irrigations (A):** | | | | | | |
| One irrigation | 9.86 c | 9.70 | 2.78 c | 2.82 c | 12.94 ab | 12.80 b |
| Two irrigation | 9.92 b | 9.79 | 2.84 b | 2.90 b | 12.90 b | 13.32 a |
| Three irrigation | 9.95 a | 9.82 | 2.88 a | 2.96 a | 13.15 a | 13.48 a |
| Sig. | ** | NS | ** | ** | ** | ** |
| **Nitrogen rates (B):** | | | | | | |
| 0 kg N/fed. | 9.42 b | 9.62 | 2.76 | 2.81 | 12.99 | 13.27 |
| 18 kg N/fed. | 9.72 b | 9.82 | 2.80 | 2.85 | 13.03 | 13.15 |
| 35 kg N/fed. | 10.8 a | 9.87 | 2.85 | 2.90 | 12.97 | 13.18 |
| Sig. | * | NS | Ns | NS | NS | NS |
| **Cultivars (C):** | | | | | | |
| Giza 123 | 10.5 a | 9.87 | 2.79 b | 2.85 b | 12.94 | 13.17 |
| Giza 126 | 10.31 a | 9.90 | 2.89 a | 2.95 a | 13.08 | 13.27 |
| Giza 2000 | 9.32 c | 9.69 | 2.87 a | 2.93 a | 13.02 | 13.11 |
| Line 2 | 9.77 b | 9.63 | 2.79 b | 2.84 b | 12.95 | 13.25 |
| Sig. | ** | NS | ** | ** | NS | NS |
| **Interactions:** | | | | | | |
| A x B | NS | NS | ** | NS | NS | NS |
| A x C | NS | NS | NS | * | NS | NS |
| B x C | NS | NS | NS | NS | NS | NS |
| A x B x C | NS | NS | NS | NS | NS | NS |

*, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.
Means designed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test (1955).

## C.3. Grain moisture content:

In both seasons, the data indicated highly significant difference between number of irrigations in moisture content. The highest values (13.15 and 13.48%) were recorded with three irrigations in 2001/02 and 2002/03 seasons, respectively.

Data in Table (11) indicate that nitrogen rates had insignificant effect on moisture content in both seasons. Also, no significant difference among cultivars for moisture content were obtained. Our results are in line with those reported by Oscarsson (1998), Sobh (2000) and El-Sayed (2003).

## C.4. Relative density:

The effect of number of irrigations on relative density was insignificant in both seasons. In general, increasing number of irrigations decreased the relative density but without significant differences. Also, the effect of nitrogen rates on relative density was insignifin in both seasons.

Data in Table (12) indicate that cultivars had highly significant effect on relative density in the second seasons only, since Giza 123 had recorded the highest values (1.22).

**Table (12): Mean values of relative density and standard germination for barley cultivars as affected by number of irrigation, nitrogen fertilizer levels and their interaction in 2001/02 and 2002/03 seasons.**

| Treatments | Relative density | | Standard germination | |
|---|---|---|---|---|
| | 2001/02 | 2002/03 | 2001/02 | 2002/03 |
| **Number of irrigations (A):** | | | | |
| One irrigation | 1.29 | 1.18 | 76.39 | 78.47 |
| Two irrigation | 1.22 | 1.18 | 78.06 | 78.33 |
| Three irrigation | 1.17 | 1.15 | 76.81 | 77.36 |
| Sig. | NS | NS | NS | NS |
| **Nitrogen rates (B):** | | | | |
| 0 kg N/fed. | 1.20 | 1.17 | 76.11 | 74.58 b |
| 18 kg N/fed. | 1.20 | 1.17 | 77.78 | 78.47 ab |
| 35 kg N/fed. | 1.20 | 1.16 | 77.36 | 81.11 a |
| Sig. | NS | NS | NS | ** |
| **Cultivars (C):** | | | | |
| Giza 123 | 1.21 | 1.22 a | 76.85 | 80.56 a |
| Giza 126 | 1.21 | 1.13 b | 76.85 | 77.22 b |
| Giza 2000 | 1.17 | 1.17 ab | 77.22 | 77.78 b |
| Line 2 | 1.22 | 1.15 b | 77.41 | 76.67 b |
| Sig. | NS | ** | NS | * |
| **Interactions:** | | | | |
| A x B | NS | NS | NS | NS |
| A x C | NS | NS | NS | NS |
| B x C | NS | NS | NS | NS |
| A x B x C | NS | NS | NS | NS |

*, ** and NS indicate P < 0.05, P < 0.01 and not significant, respectively.

Means designed by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range Test (1955).

**C.5. Standard germination:**

Data show insignificant difference between number of irrigations in both seasons. and also nitrogen rates had insignificant effect in the first season, while it had highly significant effect in the second one. In general, increasing nitrogen levels increased standard germination.

On the other side, results of analysis of variance show significant difference among cultivars in the second season only. Giza 123 recorded the highest value of standard germination (80.56).

## REFERENCES

Abo El-Enin, R.A.; I.A. Ahmed; A.A. El-Sayed; A.S. El-Gamal; A.M. El-Sherbini; A.M.O. El-BAwab; A.A. El-Hag; M.M. Abdel-Hamed; F.A. Asaad; M.A. Megahed; M.A. El-Moselhy; K.A. Moustafa; M.M. Noaman; M.M. Mahrouse and E. Dessouki (1998). Giza 124, a new barley variety for Upper Egypt. Egypt. J. Appl. Sci., 13(3): 100-109.

Abou-Ahmed, E.I. (2004). Evaluation of some barley varieties under different levels of soil moisture deficit. . Agric. Res. Tanta Univ., 30(1): 147-160.

Afifi, H.A.A. (1999). Evaluation of some barley genotypes to drought tolerance. M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.

Amer, K.A. (1999). Genetical studies on yield and leaf rust in barley. Ph.D. Thesis. Fac. of Agric. Moshtohor, Zagazig Univ., Egypt.

Assey, A.A.; M.E. Saleh; I.E. Ramadan; A.A. El-Sayed and A.M. El-Bawab (1990). Effect of irrigation and applying nitrogen on barley. Zagazig J. Agric. Res. 17(3): 613-622.

Atta, Y.E. (2002). Effect of soil moisture content on productivity and water use efficiency of some wheat cultivars under Eastern Delta conditions. Zagazig J. Agric. Res., 29(5): 1443-1456.

Birch, C.J.; S. Fukai and I.J. Broad (1997). Estimation of responses of yield and grain protein concentration of multing barley to nitrogen fertilizer using plant nitrogen uptake. Aust. J. Agric. Res., 48: 6356-648.

Duncan, D.B. (1955). Multiple range and multiple F-test. Biometrics, 11: 1-24.

El-Bably, A.Z. (1998). Studies of some stress conditions affects the growth and yield of wheat. Ph.D. Thesis. Agron. Dept. Fac. of Agric., Kafr El-Sheikh, Tanta Univ.

El-Banna, M.N.M.; A.A. Nasar; M.A. Moustafa and S.H. Abd-Allah (2002). Evaluation of some wheat genotypes under drought conditions in Nubaria region. J. Adv. Agric. Res. 7: 349-366.

El-Bawab, A.M. (1990). Effect of irrigation and applying nitrogen on barley. M.Sc. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

El-Ganbeehy, M.M. (2001). Productivity of wheat and barley under supplementary irrigation in new reclaimed land of the north west coast of Egypt. J. Adv. Agric. Res. 6: 797-808.

El-Hag, A.A. (2001). Agronomic studies on barley. Ph.D. Thesis Manosura Univ., Egypt.

El-Marsafawy, S.M. and H.M. Eid (1999). Estimation of water consumption use for Egyptian crops. 3rd Conference of on-farm irrigation and agroclimatology. Vol. 2. pp. 764 January.

El-Sayed, A.A.; M.M. Noaman; F.A. Assad; A.M. El-Sherbini; A.O. El-Bawab; A.S. El-Gamal; M. Abdel-Hameed; M. Megahed and E.E. Dessouki (1996). Registration of Giza 123 two rowed barley. crop Sci. Vol. 36. No. 6: 1715.

El-Sayed, M.A.A. (2003). Response of wheat to irrigation in sandy soils.

Zagazig J Agric. Res., Vol. 30(1): 1-15.
El-Shaarawy, G.A. (2003). Evaluation of some new wheat cultivars under some agricultural treatments. Ph.D. Thesis Fac., Agric. Al-Azhar Univ., Cairo, Egypt.
Farag, A.M.H. (2003). Response of wheat plants to some treatments of soil leveling and fertilization wheat with both nitrogen and biological fertilizers. Ph.D. Thesis, Fac. Agric. Mansoura Univ., Egypt.
Ghanem, S.A.I. and M.A. Gomaa (1985). Differential response of barley cultivars to nitrogen fertilization. Zagazig J. Agric. Res. 12: 285-303.
Gharti,C.G. and J.S. Lales (1988). Yield and yield components of spring wheat (*Triticum aestivum* L.) subjected to drought in a tropical environment. Philippine Agriculturist. 71: 165-172.
Giorgio, D.; V. Rizzo; M. Rinofdi; D.D. Giorgio and A. Scaife (1992). Growth analysis of du rum wheat applied to different nitrogen society for Agronomy, Warwick Univ. 23-28 August, pp. 56-57.
Gomez-Macpherson, H.; R.A. Richards and J. Masle (1998a). Growth of near-isogenic wheat lines differing in development spaced. Plants. Annals of Botany, 82: 315-322.
Gomez-Macpherson H.; R.A. Richards and J. Masle (1998b). Growth of near-isogenic wheat lines differing in development. plant in a simulated canopy. Annals of Botany, 82: 323-330.
Latiri, S.K.; S. Nortcliff and D.W. Lawlor (1998). Nitrogen fertilizer can increase dry matter, grain production and radiation and water use efficiencies for durum wheat under semi-arid conditions. European J. of Agronomy, 9(1): 21-34.
Maqsood, M.; A. Ali; A. Zubair; M. Saeed and S. Ahmad (2002). Effect of irrigation and nitrogen levels on grain yield and quality of wheat (*Triticum aestivum*). International J. Agric. and Biology, 4(1): 164-165.
Megahed, M.A.M. and Samia, G.A. Mohamed (2001). Evaluation of barley yield under some biofertilizers and nitrogen treatments using some statistical parameters. Zagazig J. Agric. Res. 28(6): 991-1008.
Mustafa, Kh. (2002). Dialil cross analysis of some quantiative traits in barley. Zagazig J. Agric. Res. 29(4): 1069-1079.
Noaman, M.M.; F.A. Assad; A.A. El-Sayed and A.M.O. El-Bawab (1997). Drought tolerant barley genotypes for rainfed areas in Egypt. Egyptian J. Agric. Res., 75(4): 1019-1036.
Oscarsson, M.; R. Andersson; P. Aman; S. Olofsson and A. Jonsson (1998). Effects of cultivar, nitrogen fertilization rate and environment on yield and gain quality of barley. J. Sci. Food and Agric., 78(3): 359-366. (C.F. Cd Room Computer System).
Saadia, A. Shaaban; M.S. El-Haroun and A.Y. M. El-Tawail (1983). Growth and yield response of two barley cultivars to irrigation frequency and nitrogen fertilizer. Annals Agric. Sci. Fac. Agric, Ain-Shams Univ., Cairo, Egypt. 28(3): 1387-1413.
Said, M.H. (1998). Effect of some cultural practices on wheat production M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Egypt.
Saleem, M. (2003). Response of durum and bread wheat genotypes to drought stress: Biomass and yield components. Asian Journal of Plant Sciences. 2: 290-293.
Saleh, M.E. (2000). Wheat productivity as affected by sources and levels of nitrogen fertilizer. Zagazig J. Agric. Res., 28(2): 239-250.
Snedecor, G.W. and W.G. Cochran (1967). Statistical Method 6$^{th}$ ed., Iowa State Univ. Press, Amer, Iowa, USA.
Soad, A. Youssef; E.E. El-Sheref; A.A. El-Hag and Rania A.A. Khedr (2004).

Effect of nitrogen levels and biofertilizer sources on two barley cultivars. J. Agric. Sci. Mansoura Univ., 29(12): 6787-6808.

Sobh, M.M.; M.S. Sharshar and Soad A. El-Said (2000). response of wheat to nitrogen and potassium application in salt affected soil. J. of Productivity and Devel. 5(1): 83-98 (Cited after CD. Rom).

Sorour, F.A.; M.E. Mosalem and E. Aza, E. Khaffagy (1998). Effect of preceding crop, seeding rates and nitrogen levels on wheat growth, yield and its components. J. Agric. Res., Tanta Univ. 24(3): 263-281.

Tarrad, A.M.; M.A. Megahed and Fatmaa (2002). Effect of irrigation intervals on some physiological and yield traits of barley under sprinkler irrigation system. Zagazig. J. Agric. Res., Vol. 29(3): 877-890.

Toaima, S.E.A.; Amal, A. El-Hofi and H. Ashoush (2000). Yield and technological characteristics of some wheat varieties as affected by N fertilizer and seed rates. Mansoura Univ. J. Agric. Sci., 25(5): 2449-2467.

## تأثير بعض المعاملات الزراعية على محصول الشعير وصفاته التكنولوجية

عيد المغازى محمد الشريف[١]، عبدالحميد محمد عمر[١]، عبدربه عبدالعزيز الحاج[٢] و آلاء محمد المهدى شاهين[٣]

[١] قسم المحاصيل كلية الزراعة جامعة كفرالشيخ

[٢] قسم بحوث القمح ـ معهد بحوث المحاصيل الحقلية مركز البحوث الزراعية

[٣] قسم تكنولوجيا البذور معهد بحوث المحاصيل الحقلية مركز البحوث الزراعية

أجريت تجربتان حقليتان في محطة البحوث الزراعية بسخا خلال موسمى ٢٠٠١/٢٠٠٢م ، ٢٠٠٢/٢٠٠٣م وذلك لدراسة تأثير الإجهاد الرطوبى (ثلاث معاملات من الرى وهى رية واحدة عند الزراعة فقط ، ريتين ، واحدة عند الزراعة والأخرى بعد ٤٥ يوم من الزراعة. المعاملة الثالثة ثلاث ريات الأولى عند الزراعة الثانية بعد ٤٥ يوم من الزراعة ، الثالثة بعد ٧٥ يوم من الزراعة). وثلاث مستويات من التسميد النيتروجينى وهى: (صفر ، ١٨ ، ٣٥كجم من النيتروجين/فدان) على النمو والمحصول ومكوناته وبعض صفات الجودة لأربعة أصناف من الشعير وهى جيزه ١٢٣ ، جيزه ١٢٦ ، جيزه ٢٠٠٠ ، السلالة ٢.

استخدم فى هذه الدراسة تصميم القطع المنشقة مرتين فى ثلاث مكررات حيث اشتملت القطع الرئيسيه على معاملات الرى. والقطع المنشقة على مستويات التسميد الازوتى فى حين اشتملت القطع التحت شقيه على اصناف الشعير. وأوضحت النتائج الاتى:

* أن زيادة عدد الريات أدت الى حدوث زيادة معنوية لمحصول الحبوب ومكوناته وكذلك جميع الصفات التى تم دراستها.
* ان زيادة معدل التسميد الازوتى من صفر الى ٣٥ كجم نتروجين/فدان أدت الى زيادة معنوية فى كل الصفات تحت الدراسة فيما عدا نسبة الرماد فى الحبوب ، نسبة الرطوبة فى الحبوب والكثافة النوعية للحبوب.
* اوضحت النتائج كذلك أن الصنف جيزه ١٢٣ اعطى اعلى القيم لكل من المحصول ومكوناته وكذلك بعض الصفات التكنولوجيه للحبوب.
* يمكن التوصية بزراعة الصنف جيزه ١٢٣ واضافة ٣٥ كجم/نتروجين/فدان للحصول على محصول جيد ذو جودة عالية.