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# GRAIN YIELD AND FILLING PARAMETERS AS AFFECTED BY IRRIGATION SCHEDULE IN BARLEY

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## ABSTRACT

Twelve selected barley genotypes were evaluated under three irrigation regimes to study their response to water stress at the Agric. Exp. Station, King Saud University Riyadh, Saudi Arabia. The genotypes under study consisted of 4 new varieties selected from KSU breeding program, 7 introduced varieties and the recommended cultivar Justo. The three irrigation regimes were scheduled according to the cumulative pan evaporation of 30, 60 and 120 mm and the total amount of water applied during the season was 5000 $m^3$ ($W_1$), 3000 $m^3$ ($W_2$) and 1500 $m^3$ ($W_3$). The three water regimes were assigned to main plots while the 12 genotypes were allocated to sub- plots of a split plot design with 3 replications and the experiment was conducted during 98/1999 and 1999/2000 seasons.

Moisture stress significantly reduced grain yield, days to heading, days to maturity, grain filling period and grain filling rate. Also the differences between genotypes were highly significant. The irrigation regime x genotype was highly significant indicating differential responses of genotypes to water stress. The linear regression coefficients of genotype means on amount of pan evaporation were significantly negative while four coefficients were not significant. The latter group was considered tolerant; however they were low in yield. Two genotypes were identified as tolerant to water stress. Grain yield was highly correlated with grain filling rate only.
**Keywords**: Barley, irrigation regimes, waters stress, grain filling and grain yield.

## INTRODUCTION

The availability of irrigation water as limiting crop productivity under arid and semiarid zones (Boyer, 1982; Hawell and Muscilk, 1984 and Pinter *et al.*, 1990). Accordingly, reducing water requirement of barley without affecting yield would have a priority in the barley breeding program. Moreover, increasing barley productivity under moisture stress conditions is an essential strategy in arid and semi-arid zones. Therefore, water economy could be achieved by efficient water management and breeding crops for low water requirement. Several investigators had focused on improving barley yield under water stress by selecting genotypes which had tolerance to water stress (Hanson and Nelson, 1980). In the past, progress in cereal breeding for dry areas has been less successful than breeding for favorable environments (Ceccarelli and Grando, 1996). Therefore, it was necessary to develop efficient, reliable and economical irrigation management strategies for effective use of the existing limited water resources. The traditional method for irrigation scheduling in our area is basically depending on time intervals either weekly or less or more depends on the weather conditions during the growing season. However, this traditional method is improper irrigation management practices and do waste scarce and expensive water resources. Therefore, a proper irrigation practice should be developed. The irrigation scheduling which determine the amount and frequency of irrigation is governed by many complex factors, but climate plays a major role (Wanjura *et al.*, 1990).

The meteorological-based scheduling irrigation approach, such as cumulative pan evaporation (CPE) and ratio between irrigation water applied and CPE was used by several researchers due to its simplicity and data availability (Singh, 1987; and Singh *et al.*, 1997). On the other hand, breeding for drought tolerance is very complex because unfavourable environments are intrinsically erratic in nature and the success of genotypes is not consistent (Ceccarelli and Grando, 1996). The effect of drought on grain yield may be analyzed in cereal crops in terms of yield components, some of which can assume more importance than other, depending upon the intensity of stress and growth stage (Giunta *et al.*, 1993).

Drought during grain filling, especially in Mediterranean environments, reduces the duration of grain filling and reduces grain weight (Day and Intalap, 1970 and Austin, 1989). The grain filling in barley is also known to be influenced by environmental factors such as water and heat stresses. The grain filling duration and rate had been found to be very closely correlated to final grain yield (Gebeyhou *et al.*, 1982).

The objectives of the present investigation are: (1) to study the effect of three irrigation regimes on barley yield productivity and grain filling period and rate, (2) to study the interaction between selected high yielding barley genotypes and water regimes and (3) to estimate the correlation between yield and maturity characters and the effect of water regime on the interrelationship.

## MATERIALS AND METHODS

**Materials:**

A field study was conducted during the two winter seasons of 1998/1999 and 1999/2000 at the Agriculture Research Station, King Saud University, Dirab, near Riyadh, Saudi Arabia (24° 42' N latitude and 46° 44' longitude, altitude 600 m). The soil at the experimental site was calcareous sandy loam. The experiment was conducted under flood irrigation system during the two growing seasons. Twelve barley genotypes of diverse origin were used in this study. They consisted of five Egyptian cultivars (Giza 123, Giza 124, Giza 126, Giza 127 and Giza 128), two genotypes from ICARDA (Lignee 527/NK 1272 and Rihane-03/Lignee 527) and four advanced $F_7$ lines selected from King Saud University breeding program [CC 89/Giza 123 (line 8/10/3/7)], [CC 89/Giza 124 (Line 9/9/27/16)], [Giza 121/Justo (Line 13/13/189/17)] and [Giza 123/Justo (Line 15/15/1/19)]. The recommended cultivar Justo was also included.

The layout of the experiment was a split-plot design with three replications. The main irrigation treatments were assigned to the main plots while the 12 genotypes were allocated to the sub plots. Each sub plot consisted of 4 rows, 2 m long and 20 cm wide. The cultural practices were carried out according to the recommended agronomic practices followed in

Riyadh area. Three irrigation treatments were formed by irrigation scheduled at cumulative pan evaporation (CPE) of 30 ($W_1$), 60 ($W_2$) and 120 ($W_3$) mm during the entire irrigation interval. The CPE was calculated as a sum of daily-recorded evaporation from USWB open pan. The pan was located at the meteorological station adjacent to the experiment site. The total number of irrigations for the three regimes were 10 ($W_1$), 6 for $W_2$ and only 3 for $W_3$. The total amounts of water applied during the season were 5000 $m^3$ ($W_1$), 3000 $m^3$ ($W_2$) and 1500 $m^3$ ($W_3$).

Data were collected on number of days to heading, number of days to maturity, grain yield (ton/ha), grain filling period (days to maturity - days to heading) and grain filling rate (grain yield/grain filling period, and it is expressed as g $m^{-2}$ $d^{-1}$).

**Statistical analysis**

Data from the two growing seasons were statistically analyzed using the ANOVA procedure for split plot design combined over the two years using the SAS program (SAS, 1985). Treatment and genotype effects were considered fixed. Comparisons among means were performed using FLSD procedure. To examine the genotype x irrigation regimes, linear regression procedure was applied where the genotype means in the three regions were regressed on the cumulative pan evaporation for each genotype. Also simple correlation coefficients between studied characters under the three irrigation regimes were calculated by SAS (1985).

## RESULTS AND DISCUSSION

The combined analysis of variance for data revealed highly significant effects of irrigation regimes and genotypes for all of the studied characters (Table, 1). Genotypes-water regimes interaction was also significant for all traits. The three factor interaction (genotypes, years and water regime) was significant only in case of number of days to heading.

**Table (1): Significance level from the combined analysis of variance for grain yield, days to heading, days to maturity, grain filling period and grain filling rate in barley.**

| S.O.V. | DF | Grain yield Mg/ha | Days to heading | Days to maturity | Grain filling period (days) | Grain filling rate $gm^{-2}d^{-1}$ |
|---|---|---|---|---|---|---|
| Years (Y) | 1 | ** | ** | ** | ** | * |
| Rep. (Y) | 4 | - | - | - | - | - |
| Water regimes (W) | 2 | ** | ** | ** | ** | ** |
| W x Y | 2 | ** | NS | NS | ** | ** |
| Error a | 8 | | | | | |
| Genotypes (C) | 11 | ** | ** | ** | ** | ** |
| C x Y | 22 | ** | ** | ** | ** | ** |
| C x W | 11 | ** | ** | ** | ** | ** |
| C x Y x W | 22 | NS | ** | NS | NS | NS |
| Error b | 132 | | | | | |

**NS, *, and ** indicate non significance and significance at 0.05 and 0.01 levels of probability, respectively.**

Grain yield obtained from the three irrigation regimes over the 12 genotypes were 5.62, 4.83 and 3.68 ton/ha for $W_1$, $W_2$ and $W_3$ treatments, respectively (Table, 2). Grain yield was reduced by 14% and 34% for $W_2$ and $W_3$ in comparison with the wet regime ($W_1$). These results are in consistency with those reported by previous researchers (Kobata *et al.*, 1992; Ghandorah *et al.*, 1997 and Alderfasi *et al.*, 1999).

The differences among the 12 genotypes in grain yield were significant (Table, 1). The top yielding genotypes were Rihane-03/Lignee 527 and Giza 127 without significant differences between both genotypes. Rihane-03/Lignee 527 significantly outyielded the recommended genotype Justo by about 14.37%. The lowest yielding genotypes were Giza 121/Justo (C3) and Giza 124 (C6).

**Table (2): Mean performances of water regimes, and genotypes for grain yield, days to heading, days to maturity, grain filling period and grain filling rate averaged over the two years.**

| S.O.V | | Grain yield Mg/ha | Days to Heading | Days to maturity | Grain filling period (days) | Grain filling rate $gm^{-2}d^{-1}$ |
|---|---|---|---|---|---|---|
| **Water Regime** | | | | | | |
| W1 = 30 mm+ | | 5.62a | 78.1a | 122.4a | 44.3a | 7.48a |
| W2 = 60 mm | | 4.83b | 75.0b | 117.1b | 42.1b | 6.77b |
| W3 = 120 mm | | 3.68c | 73.1c | 114.5c | 41.4c | 5.26c |
| **Genotypes** | | | | | | |
| C1 | ( CC. 89 x Giza 123) | 4.47 cd | 75.3 d | 117.1 e | 41.8 de | 6.31 bc |
| C2 | (CC 89 x Giza 124) | 4.90 bc | 75.5 d | 117.3 e | 41.8 de | 6.85 b |
| C3 | (Giza 121 x Justo) | 4.11 d | 69.1 f | 115.0 f | 45.9 b | 5.26 d |
| C4 | (Giza 123 x Justo) | 4.86 bc | 75.9 cd | 119.3 ab | 43.3 c | 6.58 bc |
| C5 | (Giza 123 ) | 4.53 cd | 77.5 b | 118.4 abc | 40.9 ef | 6.47 bc |
| C6 | (Giza 124 ) | 4.10 d | 76.4 c | 117.0 e | 40.6 f | 5.95 cd |
| C7 | (Giza 126 ) | 4.86 bc | 76.4 c | 118.3 cd | 41.9 d | 6.81 b |
| C8 | Justo | 4.87 bc | 78.6 a | 119.8 a | 41.3 def | 6.82 b |
| C9 | Lignee 527/NK 1272 | 4.58 cd | 69.2 f | 117.9 cde | 48.7 a | 5.50 d |
| C10 | Rihane-03/Lignee 527 | 5.57 a | 78.1 ab | 118.8 bcd | 40.7 f | 8.01 a |
| C11 | Giza 127 | 5.20 ab | 74.4 e | 117.9 de | 43.4 c | 6.99 b |
| C12 | Giza 128 | 4.49 cd | 78.1 ab | 118.9 abc | 40.8 f | 6.48 bc |

**Means followed by a common letter are not significantly different according to FLSD 0. 05.**
**+ of cumulative pan evaporation**

Means for days to heading, days to maturity, grain filling duration and grain filling rate for the water regimes and genotypes are given in Table 2. Irrigation at CPE $W_2$ and $W_3$ significantly reduced all the studied traits. Highly significant differences were detected among genotypes in number of days to heading and number of days to maturity (Table 2). Genotype Justo (C8) was the latest in both characters; meanwhile Giza 121 x Justo (C3) and Lignee 527/NK 1272 (C9) were the earliest. However, the difference between the latest and the earliest in grain filling period did not exceed 6 days. Therefore both days to heading and days to maturity had small contribution to the tolerance to drought.

Grain filling period for the studied genotypes ranged from 40.6 days for Giza 124 (C6) to 48.7 days for Lignee 527/NK 1272 (C9), (Table, 2). It seems that the length of this period had small contribution to yield as the highest yielding genotype (Rihane-03/Lignee 527) and the lowest yielding cultivar

(Giza 124) had almost the same grain filling period being 40.7 and 40.6 days, respectively.

Grain filling rate for the genotypes ranged between 5.26 g for Giza 121/Justo (C3) to 8.01 g for Rihane-03/Lignee 527 (C10). This character was highly associated with yield as Rihane-03/Lignee 527 was the highest yielding genotype while Giza 121/Justo was among the lowest yielding genotypes (Table, 2).

Data presented in Table (3) revealed that grain yield obtained from all genotypes showed significant reduction due to water deficit. However the rate of reduction differed among genotypes as the interaction irrigation x genotype was significant. The highest grain yield (6.80 ton/ha) was obtained by Rihane-03/Lignee 527 followed by Justo (6.43 ton/ha), Giza 127 (6.18 ton/ha) and CC 89/Giza 124 (6.17 ton/ha). The differences between the productivity of the four aforementioned genotypes did not reach the level of significance.

**Table (3): Genotype means under the three water regimes (W) averaged over the two years for the five traits under study**

| Genotypes | Water regime | Grain yield ton/ha | Days to heading | Days to maturity | Grain filling period (days) | Grain filling rate $gm^{-2}d^{-1}$ |
|---|---|---|---|---|---|---|
| 1 CC 89 x Giza 123 | $W_1$ | 4.74 | 78.2 | 121.2 | 43.0 | 6.51 |
| | $W_2$ | 4.94 | 75.2 | 115.0 | 39.8 | 7.28 |
| | $W_3$ | 3.73 | 72.7 | 115.2 | 42.5 | 5.15 |
| 2 CC 89 x Giza 124 | $W_1$ | 6.17 | 79.0 | 122.7 | 43.7 | 8.30 |
| | $W_2$ | 4.72 | 74.7 | 116.0 | 44.7 | 6.66 |
| | $W_3$ | 3.82 | 73.8 | 112.8 | 40.0 | 5.60 |
| 3 Giza121 x Justo | $W_1$ | 4.90 | 72.7 | 120.3 | 47.7 | 6.06 |
| | $W_2$ | 4.39 | 68.5 | 114.0 | 45.5 | 5.61 |
| | $W_3$ | 3.09 | 66.0 | 110.7 | 44.7 | 4.12 |
| 4 Giza 123 x Justo | $W_1$ | 5.76 | 76.7 | 122.7 | 46.0 | 7.40 |
| | $W_2$ | 4.53 | 76.8 | 119.0 | 42.2 | 6.31 |
| | $W_3$ | 4.29 | 74.3 | 116.2 | 41.8 | 6.04 |
| 5 Giza 123 | $W_1$ | 5.39 | 79.8 | 122.7 | 42.8 | 7.39 |
| | $W_2$ | 4.45 | 76.8 | 117.5 | 40.7 | 6.42 |
| | $W_3$ | 3.74 | 75.8 | 115.2 | 39.3 | 5.59 |
| 6 Giza 124 | $W_1$ | 4.89 | 79.2 | 122.0 | 42.2 | 6.83 |
| | $W_2$ | 4.34 | 75.7 | 115.8 | 40.2 | 6.22 |
| | $W_3$ | 3.19 | 74.5 | 113.8 | 39.3 | 4.78 |
| 7 Giza 126 | $W_1$ | 5.03 | 79.2 | 124.7 | 42.8 | 6.87 |
| | $W_2$ | 5.42 | 76.2 | 117.8 | 41.7 | 7.64 |
| | $W_3$ | 4.14 | 73.8 | 115.0 | 41.2 | 5.91 |
| 8 Justo | $W_1$ | 6.43 | 81.3 | 124.7 | 43.3 | 8.59 |
| | $W_2$ | 5.02 | 78.3 | 118.7 | 40.3 | 7.21 |
| | $W_3$ | 3.15 | 76.0 | 116.2 | 40.2 | 4.65 |
| 9 Lignee 527/NK 1272 | $W_1$ | 5.41 | 72.5 | 123.3 | 50.8 | 6.25 |
| | $W_2$ | 4.24 | 68.0 | 116.0 | 48.2 | 5.16 |
| | $W_3$ | 4.08 | 67.0 | 114.3 | 47.2 | 5.09 |
| 10 Rihane-03/Lignee 527 | $W_1$ | 6.80 | 80.2 | 122.0 | 41.8 | 9.55 |
| | $W_2$ | 5.85 | 78.2 | 119.0 | 40.8 | 8.40 |
| | $W_3$ | 4.06 | 76.0 | 115.3 | 39.3 | 6.08 |
| 11 Giza 127 | $W_1$ | 6.18 | 77.2 | 122.3 | 45.2 | 8.04 |
| | $W_2$ | 5.77 | 73.3 | 117.0 | 43.7 | 7.77 |
| | $W_3$ | 3.66 | 72.8 | 114.3 | 41.5 | 5.17 |
| 12 Giza 128 | $W_1$ | 5.76 | 80.8 | 123.5 | 42.7 | 7.95 |
| | $W_2$ | 4.59 | 78.0 | 118.5 | 40.5 | 6.53 |
| | $W_3$ | 3.26 | 75.3 | 114.7 | 39.3 | 4.96 |
| **LSD .05 for C/W** | **0.89** | **1.2** | **1.7** | **1.6** | **0.76** | |

**$W_1$, $W_2$ and $W_3$ irrigation at 30 , 60 and 120 mm of cumulative pan evaporation , respectively .**

Under the most severe conditions ($W_3$), the Line Giza 123/Justo (C4) ranked first in grain yield (4.29 ton/ha) followed by the Egyptian check cultivar for rainfed areas Giza 126 (C7), Lignee 527/NK 1272 (C9) and Rihane-03/Lignee 527 (C10) without significant differences among them.

The reaction of grain filling period to water stress was almost similar for the different genotypes except C1 (Table, 3). All the genotypes showed consistent reduction in the length of this period except C1. However, the magnitude of the reduction varied for the different genotypes resulting in the significance of genotype x irrigation regimes

The linear regression equation would describe the differential reaction of the genotypes to water stress. The regression coefficient (b) is the rate of reduction in yield for water stress. The three statistics of the linear regression equations are given in Table 4.

Significant reduction in grain yield was detected for all the genotypes except genotypes numbers 1, 4, 7, and 9. The rate of reduction was associated with the productivity of the genotype. The high yielding genotypes, Justo (C8), Rihane-03/Lignee 527 (C10), Giza 127 (C11), and Giza 128 (C12) had the highest rate of reduction. On the other hand, the low yielding genotypes, i.e., CC 89/Giza 123 (C1), Giza 123/Justo (C4), Giza 126 (C7) and Lignee 527/NK 1272 (C9) had non significant reduction due to water stress. Among this group, Giza 123/Justo was moderate in yield under the wet condition and the top yielding genotype under limited water. This genotype would be recognized as tolerant genotype. On the other hand, the high yielding genotype Rihane-03/Lignee 527 produced the highest grain yield under wet condition and gave moderate yield under stress condition. This genotype could be recommended for both stress and non stress conditions. This approach by breeding for high yielding genotypes under non-stress condition, and might compact stress under limited water. The present results would suggest that in order to screen genotypes for stress condition, the genotypes should be evaluated under non-stress as well as stress conditions to assess their yield potentiality and tolerance.

**Table (4): Estimates of linear regression equation parameters of genotype grain yield on amount of cumulative pan evaporation in mm averaged over the two years.**

| Genotype | | Linear regression statistics | | |
|---|---|---|---|---|
| | | a | b | $r^2$ |
| 1 | CC. 89 x Giza 123 | 5.34 | -0.012 | 0.78 |
| 2 | CC. 89 x Giza 124 | 6.62 | - 0.024 ** | 0.89 |
| 3 | Giza 121 x Justo | 5.53 | - 0.020 * | 1.00 |
| 4 | G 123 x Justo | 5.88 | - 0.015 | 0.72 |
| 5 | Giza 123 | 5.74 | - 0.017 * | 0.93 |
| 6 | Giza 124 | 4.11 | - 0.019 * | 0.99 |
| 7 | Giza 126 | 5.67 | - 0.011 | 0.65 |
| 8 | Justo | 7.36 | - 0.036 ** | 0.99 |
| 9 | Lignee 527/NK 1272 | 5.49 | - 0.013 | 0.68 |
| 10 | Rihane | 7.69 | - 0.030 ** | 1.00 |
| 11 | Giza 127 | 7.23 | - 0.029 ** | 0.97 |
| 12 | Giza 128 | 6.35 | - 0.029 ** | 0.96 |

***, ** indicate significance from B = 0 at 0.05 and 0.01 levels of probability, respectively.**

The present results are in general agreement with the results reported by Ghandorah *et al.* (1997). They all reported that there are genotypic variations for drought tolerance and demonstrated that reaction of drought stress varied from one genotype to another with respect to barley and wheat.

The interaction between genotype and irrigation regime was significant due to the differential reduction of this character with water stress. All the genotypes, except C1, showed consistent reduction. However, the magnitude of reduction differed from one genotype to another.

To examine the effect of genotype x irrigation regime, correlation coefficient between the same characters in two irrigation regimes was calculated and their values are given in Table 5. Days to heading showed little effect of interaction as the correlation coefficients were above 0.93. Number of days to maturity was affected by genotype x irrigation interaction as the correlation coefficient was moderate ranging from 0.59 to 0.77. Grain filling period was similar in behavior to days to heading and their correlation coefficient ranged from 0.878 to 0.95.

**Table (5): Correlation coefficients between the studied characters under different irrigation regimes.**

| Character | Irrigation regime (W) | | |
|---|---|---|---|
| | $W_1$ & $W_2$ | $W_1$ & $W_3$ | $W_2$ & $W_3$ |
| Days to heading | 0.939** | 0.948** | 0.973** |
| Days to maturity | 0.656* | 0.591* | 0.777** |
| Grain filling period | 0.950** | 0.922** | 0.878** |
| Grain filling rate | 0.678* | 0.415 | 0.473 |
| Grain yield | 0.530 | 0.154 | 0.271 |

*** and ** indicate significance at the 0.05 and 0.01 levels of probability , respectively.**
**$W_1$, $W_2$ and $W_3$ irrigation at 30, 60 and 120 mm of cumulative pan evaporation, respectively.**

For both grain filling rate and grain yield, the interaction affected the rank of genotypes within the irrigation regime especially between $W_3$ and each of $W_1$ or $W_2$. Therefore, the performance of the different genotypes under $W_3$ cannot be detected from their performance under $W_1$ or $W_2$. Therefore, in order to breed for drought tolerance, screening of the different genotypes should be performed under non stress as well stress conditions (Ghandorah *et al.*, 1997).

The interrelationship between the studied characters is presented in Table 6. Number of days to heading was negatively correlated with grain filling period and positively correlated with both days to maturity and grain filling rate. On the other hand, number of days to heading was independent from grain yield; this might be due to the limited variation in days to heading. Number of days to maturity was significantly correlated with grain yield at the wet environment only. This is expected as delaying maturity should be advantageous under non-stress water condition only; grain filling period was independent from grain yield under the three irrigation regimes. The non significance might be due to the limited differences in grain filling period for the 12 genotypes. Finally, grain filling rate was highly significantly correlated with grain yield under the three water regimes. Grain filling rate is derived from grain yield as it is estimated as grain yield divided by grain filling period. Since the variation in grain filling period was limited, the correlation would be high between the two characters (grain yield and grain filling rate).

The present results indicated that the genetic variation observed among barley genotypes in grain productivity can be implicated in barley breeding program for direct selection for drought tolerance if supported by indirect criteria such as those traits under the present study.

**Table (6): Correlation coefficients between the studied traits under the three irrigation regimes calculated from the genotype means.**

| S.O.V. | Irrigation regime | Days to maturity | Grain filling period (days) | Grain filling rate gm-2d-1 | Grain yield |
|---|---|---|---|---|---|
| Days to heading | $W_1$ | 0.369 | - 0.919** | 0.677* | 0.393 |
| | $W_2$ | 0.750** | - 0.900** | 0.629* | 0.359 |
| | $W_3$ | 0.678 | - 0.918** | 0.503 | 0.066 |
| Days to maturity | $W_1$ | | - 0.003 | 0.476 | 0.586* |
| | $W_2$ | | - 0.389 | 0.475 | 0.394 |
| | $W_3$ | | - 0.342 | 0.546 | 0.415 |
| Grain filling period | $W_1$ | | | - 0 532 | - 0.176 |
| | $W_2$ | | | -0.569* | - 0.248 |
| | $W_3$ | | | - 0.374 | 0.175 |
| Grain filling rate | $W_1$ | | | | 0.925** |
| | $W_2$ | | | | 0.936** |
| | $W_3$ | | | | 0.874** |

***, ** indicate significance at 0.05 and 0.01 levels of probability, receptively.**
**$W_1$, $W_2$ and $W_3$ irrigation at 30, 60 and 120 mm of cumulative pan evaporation, respectively.**

In conclusion, evaluation of barley genotypes for tolerance to drought should be performed at two environments, stress and non stress water regime. Among the tested genotypes, two entries were tolerant with two different mechanisms. The first genotype, Rihane-03/Lignee 527 (C10), was identified because it was high yielding therefore it tolerated the reduction in yield under the stress environment. The second genotype, Giza 123 X Justo (C4) showed good tolerance under water stress conditions; however it was moderate in yield under optimum condition. It is expected that the latter genotype would posse's genes for tolerance to drought. From a breeding point of view, both genotypes could be used in future breeding programs as drought tolerant genotypes.

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**تأثير كمية مياه الري على محصول الشعير وعوامل امتلاء الحبوب** ٦٠

**خالد أحمد مصطفى**
**قسم بحوث الشعير – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – مصر.**

أجرى هذا البحث في محطة التجارب الزراعية بجامعة الملك سعود بالرياض بالمملكة العربية السعودية في موسمي الزراعة ١٩٩٨/١٩٩٩ ، ١٩٩٩/٢٠٠٠ . وذلك لدراسة استجابة ١٢ صنف منتخب من الشعير للإجهاد المائي وكان تصميم التجربة قطاعات كاملة العشوائية في قطع منشقة في ثلاثة مكررات . اشتملت القطع الرئيسية على معدلات الإجهاد المائي وهى ثلاثة كميات من الاحتياجات المائية للشعير ٥٠٠٠ ، ٣٠٠٠ ، ١٥٠٠ م٣ في حين وضعت الأصناف في القطع المنشقة والأصناف المختبرة تشتمل على أربعة أصناف منتخبة من برنامج الشعير بالجامعة و٧ أصناف مستوردة بالإضافة إلى الصنف التجاري بالمنطقة . وقد أوضحت النتائج وجود تأثير كبير للإجهاد المائي على كل الصفات المدروسة حيث لوحظ انخفاض معنوي في محصول الحبوب وتاريخ طرد السنابل وتاريخ النضج وفترة ومعدل امتلاء الحبوب كذلك وجد اختلافات معنوية بين الأصناف لمعدلات الإجهاد المائي وأيضاً وجد تفاعل معنوي بين الأصناف ومعدلات الإجهاد المائي بالنسبة لجميع الصفات المدروسة وهذا يوضح مدى تأثر الأصناف بالإجهاد المائي . وقد أظهرت النتائج وجود علاقة معنوية وموجبة بين فترة امتلاء الحبوب ومحصول الحبوب . قد أمكن التوصل إلى صنفين لهما مقدرة عالية على تحمل الإجهاد المائي . مما يوجب استخدام هذه الأصناف في برنامج التربية لإنتاج أصناف مقاومة للإجهاد المائي .