PERFORMANCE AND STABILITY PARAMETERS OF SOME BREAD WHEAT GENOTYPES (*TRITICUM AESTIVUM* L.) UNDER DIFFERENT ENVIRONMENTS IN UPPER EGYPT

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Abstract

The present investigation was carried out at Shandaweel Agricultural Research Station, ARC, Egypt, during the three seasons of 2004/2005 to 2006/2007. The objectives were to evaluate some bread wheat genotypes and to identify the most stable ones under heat stress conditions in Upper Egypt. Twelve bread wheat genotypes were evaluated under nine environments which are the combination between three sowing dates i.e. 25 November, 10 December and 25 December during the three winter growing seasons. The studied traits included days to heading, no. of spikes/m^2, no. of kernels/spike, 1000-kernel weight and grain yield t/ha. Performance of the twelve wheat genotypes showed different responses to the different environments. The combined analysis of variance showed highly significant differences among planting dates and genotypes for all studied traits. Delaying sowing date reduced no. of days to heading, no. of spikes / m^2, no. of kernels /spike, 1000-kernel weight and grain yield t/ha in the second and third planting dates by an average of (5.41 & 12.15 %), (4.45 & 10.90 %), (8.88 & 16.77 %), (5.21 & 10.80%) and (21.14 & 36.2 %), respectively, compared with the recommended sowing date.

The joint regression analysis of variance indicated highly significant differences among genotypes for all the studied traits. Moreover, partitioning mean squares due to environments plus genotype x environment interaction (E + (G x E)) indicated that E (Linear) showed highly significance for all the studied traits, while G×E component mean squares was insignificant for all the studied traits, except no. of spikes/m^2 and 1000-kernel weight. The remainder sum of squares was significant for days to heading, no. of kernels/spike , 1000-kernel weight and grain yield t/ha. However, five genotypes (Sids 1, Giza 168, Sakha 94, Line # 7 and Debeira) could be considered the best, since they had higher grain yield and acceptable stability.

Data of heat susceptibility index for grain yield under normal and late sowing dates indicated that six genotypes (Sids 1, Giza 168, Line # 3, Sakha 94, Line # 5 and Debeira) seemed to be tolerant and produced high grain yield under heat stress.

Key words: *Wheat genotypes, Triticum aestivum, Heat stress, Stability parameters, Heat susceptibility index (HSI)*

INTRODUCTION

Wheat *(Triticum aestivum.)* is the most important cereal crop in terms of its total acreage and production, also it is a stable diet for more than one third of the world population. Wheat contributes more calories and protein to the world diet than any other cereal crop (Poehlman, 1987).

Heat stress is a common abiotic stress that causes stunted plants, reduced tillering, and accelerates development leading to small heads, shrivelled grains and finally low yields (Al–Khatib et al. 1984. and Wardlaw et al. 2002). Respecting agronomic traits affected by this abiotic stress such as days to heading, days to maturity, plant height and grain yield are easily identifiable and can be used as indices for heat tolerance. Understanding the nature of genotype x environment interaction empowers breeders to test and select more efficient genotypes. Breeding genotypes with wide adaptability has long been a universal goal among plant breeders. To achieve this goal, evaluating breeding lines over time and locations has become an integral part of any plant breeding program. Adaptability and stability performance of cultivars over environments are important for national policy in crop production, therefore, a grain producer is interested primarily in growing a cultivar with high yield and stability performance at his location.

Several investigators had attempted to estimate G x E numerically. Two estimates developed by Eberhart and Russell (1966). The first is the regression coefficient (b_i) of a line on environmental indices that estimate its response to favorable conditions, while the remainder sums of squares after the regression (S^2d_i) illustrate the latter un-described interaction effects. They defined a stable cultivar as one, which had a regression coefficient (b_i) equal to 1.0 and with (S^2d_i) equal to, or does not deviate significantly from 0.0. Apparently, a cultivar that did not meet both qualifications would be closed as unstable. However, an ideal cultivar would have both a high average performance over a wide range of environments plus stability.

Abd-Elghani et al. (1994) stated that regression analysis as well as grain yield *per se* could be useful tools for identifying high yielding thermo-tolerant genotypes. On the other hand, El-Morshedy *et. al.* (2000) revealed that most of the variations in the total sum of squares of days to heading and grain yield were due to the environmental variations, which were, in consequences, attributed to the main effects of the used environmental factors (year, sowing date and irrigation) while the interaction of year x sowing date had the second importance. Tawfelis (2006 a) studied the performance and stability of 40 bread wheat genotypes under eight environments. The joint regression analysis of variance indicated highly significant differences among genotypes for all the studied characters. The heterogeneity of linear responses and remainder sums of squares were highly significant for all the studied traits. The regression coefficient was positively correlated with the mean performance indicating that high yielding genotypes had generally, and positive $ß_i$ values and revealed a good response to the improving environments.

The objectives of this study were to examine the magnitude of G *x* E interaction as well as to assess the stability parameters of grain yield and its components of twelve bread wheat genotypes under heat stress conditions in Upper Egypt to identify the most stable genotypes under these conditions.

MATERIALS AND METHODS

The present investigation was conducted at Shandaweel Agricultural Research Station, Agricultural Research Center, Egypt. During 2004 / 2005 to 2006/2007 growing seasons. Names and pedigree of the twelve bread wheat genotypes under investigation are presented in Table (1).

Table 1.The pedigree and origin of the twelve studied genotypes:

Ent. No.	*Entry name*	*Pedigree*	*Origin*
1	*Sids 1*	*HD2172 / Pavon"s" //1158.57/ Maya 74"s"*	*Egypt*
2	*Giza 168*	*Mill / Buc // Seri*	*Egypt*
3	*Line # 3*	*Caza / Kauz // Kauz.*	*CIMMYT*
4	*Sakha 94*	*Opata / Rayon // Kauz*	*Egypt*
5	*Line # 5*	*SKAUZ*2/SRIMA*	*Egypt*
6	*Gemmiza # 10*	*Maya 74"s"/on // 1160-147 /3/ Bb /4/ Chat"s" /5/ Ctow.*	*Egypt*
7	*Line # 7*	*Maya"s"/ Crow // Vee"s"*	*CIMMYT*
8	*Line # 8*	*Maya"s"/Mon"s"/4/CMH7.428/MRC//Jup/3/582/5/A_2. Sakha8/6/Sakha 69*	*CIMMYT*
9	*Gemmiza # 9*	*Ald"s"/ Huac"S" //CMH74A.630/5x*	*Egypt*
10	*El-Nelin*	*S 948.A_1/7*STE*	*Sudan*
11	*Debeira*	------------------------	*Sudan*
12	*HD2501*	------------------------	*India*

Sowing dates were 25th November, 10th and 25th December in the three seasons, respectively. The experimental design was randomized complete block (RCBD), with three replications for each planting date. The plot size was 3.5m long with 2.4m width (3.5 x 2.4 = 8.4m^2). Each plot included 12 rows, 20cm apart between rows and seeds were spaced 5cm within rows. The recommended practices of wheat production were applied all over the growing seasons.

Data were recorded for five agronomic characters as following:-

1-Days to heading: measured as number of days from planting to 50% of the heads appeared beyond the flag leaf sheath.

2-Number of spikes/m² (no.S/m²): average number of spikes/m^2 of three samples from each experimental plot.

3- Number of kernels/spike: estimated as an average of grains of ten spikes

4-1000-kernel weight (g): determined as an average weight of 1000 grains from the bulk of the plot

5- Grain yield/plot: computed from the weight of grains from the ten middle rows (plot area 7 m^2).

Meteorological Data:

The monthly mean temperature differed from season to another (Table 2). The mean of maximum and minimum temperature from the date of sowing to booting, booting to heading and heading to maturity of favorable and late sowing dates (heat stress) are summarized in Table (2). The differences in the maximum temperature at Sohag between late and favorable sowing dates were 0.1 °C, 1.87 °C and 2.06 °C in the period, sowing to booting, booting to heading and heading to maturity, respectively. The temperature in Table (2) indicated that the degree cent great missing during grain filling period under late sowing date.

Table 2. Mean maximum (Max) and minimum (Min) air temperature (°C) during growth stage in normal and late sowing at Sohag Governorate:

Months	2004 / 2005		2005 / 2006		2006 / 2007	
	Max	Min	Max	Min	Max	Min
November	27.90	11.50	25.90	10.00	24.03	10.69
December	22.10	6.60	23.40	9.00	21.34	6.88
January	20.20	5.40	21.50	6.80	19.33	5.16
February	23.30	7.60	23.50	8.90	27.48	8.52
March	25.60	9.40	26.60	11.00	27.68	11.29
April	36.80	16.20	30.10	14.60	34.67	21.63

Sowing dates	*sowing to booting*		*first booting to heading*		*heading to maturity*	
	Max	Min	Max	Min	Max	Min
Optimum	22.31	7.38	24.76	8.34	27.48	11.30
Late	22.41	7.08	26.63	10.56	29.54	13.36

Shandaweel 26°36'N, 31°38 E. alt 58.0 m asl.

Statistical analysis:

Data were subjected to the standard analysis of variance and the combined analysis of variance over nine environments was performed according to Gomez and Gomez (1984) and stability parameters were estimated by the method described by Eberhart and Russell (1966).

A stress-susceptibility index (S) was used to characterize each genotype in the stress environments and the index was calculated using genotype means and a generalized formula (Fischer and Maurer 1978) in which $S= (1-YD/ YP)/ D$, were YD = mean yield in stress environment, YP = potential yield in normal environment, D = environment stress intensity = 1-(mean YD of all genotypes / YP of all genotypes).

RESULTS AND DISCUSSION

The combined analysis of variance showed highly significant differences among years for days to heading, no. of spikes/m^2, number of kernels/spike, 1000-kernel weight (g) and grain yield t/ha (Table 3). These results reflect the wide differences in climatic conditions prevailing during the growing seasons. The main effect of sowing dates was highly significant for all studied traits. The studied genotypes also differed highly significantly for all traits, reflecting the genetic diversity among them. The first order interaction of years x dates significantly for all traits, indicating the different influences of climatic conditions on sowing date. Otherwise, significant interaction between years x genotypes was found for all traits. The combined analysis of variance showed significant interaction between genotypes and sowing dates for all studied traits (Table 3). Accordingly, there was a differential response between genotypes to sowing dates and years. These results indicate that wheat genotypes responded differently to the different environmental conditions, suggesting the importance of assessment of genotypes under different environments in order to identify the best genetic make up for a particular environment. Similar results were obtained by Kheiralla *et. al.* (1997), Abdel-Shafi *et. al.* (1999), El-Morshidy *et. al.* (2001) ,Tammam & Tawfelis (2004) and Tawfelis (2006 a & b).

Table 3. Mean squares of the combined analysis of variance for the studied characters over all sowing dates and seasons.

Source of variation	D.F	*Mean squares (M.S.)*				
		Days to heading	Number of spikes/ m^2	Number of kernels/spike	1000-kw (g)	Grain yield t /ha
Year (Y)	2	1688.84 **	5438.26 **	2833.11 **	172.07 **	14.67**
Rep./Y (Error a)	6	3.38	196.80	1.80	3.78	0.25
Dates (D)	2	3672.01 **	59293.4 **	2092.41 **	574.81 **	207.47**
Y x D	4	47.09 **	2330.98 **	135.11 **	8.73 *	4.34**
Error b	12	2.75	200.39	8.17	2.48	0.26
Genotypes(G)	11	99.74 **	2938.56 **	117.67 **	58.69 **	1.93**
Y x G	22	20.95 **	540.75 *	44.62 **	11.96 **	0.90**
D x G	22	7.11 **	818.52 **	8.43 *	3.25 *	0.87**
Y x D x G	44	6.75 **	278.10	16.41 **	2.63	0.75**
Pooled error	198	1.91	303.82	4.52	1.88	0.19

* and ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

I) Performance of genotypes

(1) Days to 50% heading

The performance of the twelve bread wheat genotypes in the nine environments is presented in Table (4).The average number of days to heading over all environments ranged from 87.26 days for El-Nelin to 93.26 days for Gemmiza 10 with an average of 90.16 days. These results indicated that Giza 168, El-Nelin and Debeira are earlier in heading than the grand mean over all environments under Upper Egypt conditions.

Late planting date caused a reduction in number of days to heading in the second and third planting dates by an average of 5.40 and 12.15 %, respectively as compared with the optimum planting dates. This reduction could be due to the fact that heat units and the accumulated metabolites required for wheat flowering were reduced in the late planting dates. These results are in line with those obtained by El-Morshidy et al (2001) and Tammam and Tawfelis (2004)

(2) Number of spikes/m^2:

The performance of the studied bread wheat genotypes in the nine environments are presented in Table (5).The average number of spikes/m^2 over years varied from 402.22 for Gemmeiza 10 to 452.00 spikes/m^2 for Debeira with an average of 425.15 spikes/m^2, from 381.78 for Gemmeiza 9 to 420.44 spikes/m^2 for Line # 5 with an average of 406.04 spikes/m^2 and from 354.22 for Gemmeiza 9 to 398.22

spikes/m^2 for Line # 5 with an average of 378.54 spikes/m^2 in the three respective sowing dates.

The average number of spikes/m^2 over all environments ranged from 381.19 spikes/m^2 for Gemmeiza 9 to 418.67 spikes/m^2 for Line # 5 with an average of 403.24 spikes/m^2. These results indicated that Giza 168, Line # 5 and Debeira had the highest no. of spikes/ m^2 compared with the grand mean over all environments under Upper Egypt conditions..

It is clear that delaying planting date to December 10 or 20 caused a reduction in number of spikes/m^2 by an average of 4.50 and 10.96 %, respectively as compared with the optimum planting date. Similar results were obtained by Tammam and Tawfelis (2004) and Seleem (2007).

(3) Number of kernels/spike:

The performance of the studied genotypes in the nine environments is presented in Table (6).The average number of kernels/spike over all years ranged from 49.32 for El-Nelin to 55.92 kernels for Line # 5 with an average of 52.47 kernels, from 43.95 for Debeira to 52.08 kernels for Line # 3 with an average of 47.81 kernels and from 40.10 for HD 2501 to 46.57 kernels for Line # 3 with an average of 43.67 kernels in the three planting dates, respectively.

The average number of kernels/spike over all environments ranged from 44.86 kernels for Debeira to 51.07 kernels for Line # 3 with an average of 47.98 kernels. These results indicated that Line # 3, Line # 5, Gemmeiza 10 and Line # 8 have high no. of kernels/spike compared with the grand mean over all environments under Upper Egypt conditions.

It is clear that late planting caused a reduction in number of kernels/spike in the second and third planting dates by an average of 8.88 and 16.77 %, respectively as compared with the optimum planting date. Similar results were obtained by Tammam and Tawfelis (2004), Tawfelis (2006a) and Seleem (2007)

(4) 1000-kernel weight (g):

The performance of the studied genotypes in the nine environments for kernel weight is presented in Table (7). The average of 1000-kernel weight over all environments ranged from 37.66 gm for Line # 5 to 43.39 gm for Sids 1 with an average of 40.07 gm. These results indicated that Sids1, Sakha 94, El-Nelin and HD 2501 have the heaviest 1000-kernel weight compared with the grand mean over all environments under Upper Egypt conditions.

It is clear that late planting caused a reduction in 1000-kernel weight in the second and third planting dates by an average of 5.27 and 10.80 %, respectively as compared with the optimum planting date. Similar results were obtained by Ismail (1995), Tammam and Tawfelis (2004), Tawfelis (2006 b) and Seleem (2007).

Table 4. Average number of days to heading for the twelve bread wheat genotypes under three planting dates in the three seasons and over all seasons.

Genotype	2004/2005				2005/2006				2006/2007				Combined over all years			Average over all	Reduction %	
	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3		D2-D1/D1	D3-D1/D1
Sids 1	92.00	86.33	79.67	86.00	93.67	91.33	85.00	90.00	97.67	96.33	88.67	94.22	94.44	91.33	84.44	90.07	3.29	10.59
Giza 168	90.33	83.67	78.67	84.22	93.33	89.00	82.00	88.11	95.00	93.67	86.00	91.56	92.89	88.78	82.22	87.96	4.43	11.49
Line # 3	94.67	87.33	79.67	87.22	93.33	92.00	83.00	89.44	100.67	96.67	87.67	95.00	96.22	92.00	83.44	90.55	4.39	13.28
Sakha 94	92.33	86.00	79.67	86.00	95.33	91.33	81.00	89.22	99.00	94.67	87.33	93.67	95.56	90.67	82.67	89.63	5.12	13.49
Line # 5	94.00	86.33	80.33	86.89	95.00	92.67	82.33	90.00	99.00	94.33	87.33	93.56	96.00	91.11	83.33	90.15	5.09	13.20
Gemmeiza 10	97.00	88.33	84.00	89.78	95.67	93.00	87.00	91.88	103.67	99.67	91.00	98.11	98.78	93.67	87.33	93.26	5.17	11.59
Line # 7	96.67	89.00	83.67	89.78	95.33	91.67	87.33	91.44	103.67	98.67	92.00	98.11	98.56	93.11	87.67	93.11	5.53	11.05
Line # 8	95.00	89.33	82.33	88.89	94.67	89.00	82.67	88.77	100.33	93.67	88.33	94.11	96.67	90.67	84.44	90.59	6.21	12.65
Gemmeiza 9	96.67	90.00	85.00	90.56	96.33	84.67	80.33	87.11	102.67	98.67	92.00	97.78	98.56	91.11	85.78	91.82	7.56	12.97
El-Nelin	91.67	81.00	75.67	82.78	92.00	87.00	82.00	87.00	96.33	93.00	86.67	92.00	93.33	87.00	81.44	87.26	6.78	12.74
Debeira	88.67	83.67	79.33	83.89	89.33	86.00	83.00	86.11	98.00	95.00	87.33	93.44	92.00	88.22	83.22	87.81	4.11	9.54
HD2501	96.33	82.00	76.33	84.89	95.67	92.00	88.00	91.88	96.67	94.00	86.33	92.33	96.22	89.33	83.56	89.70	7.16	13.16
Average	93.78	86.08	80.36	86.74	94.14	89.97	83.64	89.25	99.39	95.69	88.39	94.49	95.76	90.59	84.13	90.16	5.40	12.15

L.S.D	0.05	0.01	L.S.D	0.05	0.01
Years (Y)	0.42	0.57	Y x G	1.15	1.51
Dates (D)	0.42	0.57	D x G	1.31	1.72
Genotypes (G)	0.71	0.95	Y x D x G	2.27	2.97
Y x D	0.75	0.99			

(5) Grain yield (t/ha):

The grain yield of the twelve bread wheat genotypes in the nine environments is presented in Table (8).The average grain yield over all environments ranged from 5.77 t/ha for Line # 8 to 6.69 t/ha for Sids 1 with an average of 6.17 t/ha. The results indicated that Sids 1, Giza 168 and Sakha 94 produced the highest grain yield compared with the grand mean over all environments under Upper Egypt conditions.

Late planting caused a reduction in grain yield in the second and third planting dates by an average of 21.13 and 36.22 %, respectively, compared to the optimum planting date. That might be due to the optimum environmental factors dominating in the first planting date compared to late sowing and consequently plants became more efficient in utilizing growth factors such as nutrients, water and light which was reflected in growth with high yielding potential. Similar results were obtained by El- Morshidy et al. (1998), Hamada *et. al.* (2002), Tammam and Tawfelis (2004) and Tawfelis (2006 a).

According to the data of days to heading (Table 4) and those obtained from grain yield Table (8), wheat genotypes Giza 168, Line # 3, Sakha 94 and Line # 5 were earlier in heading, coupled with higher grain yield and lower reduction % compared to the other genotypes and the average mean. Therefore, in regions of the terminal heat stress, breeder seeks for genotypes of shorter grain filling duration like Giza 168, Line # 3, Sakha 94 and Line # 5 to escape or at least to minimize the detrimental effect of heat stress on grain yield.

Table 5. Average number of spikes/m^2 for the twelve bread wheat genotypes under three planting dates in the three seasons and over all seasons.

Genotype	2004/2005				2005/2006				2006/2007				Combined over all years			Average over all	Reduction %	
	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3		D2-D1/D1	D3-D1/D1
Sids 1	464.00	402.67	392.00	419.56	416.00	405.33	388.00	403.11	416.00	398.67	384.00	399.56	432.00	402.22	388.00	407.41	6.89	10.19
Giza 168	456.00	416.00	374.67	415.56	442.67	430.67	396.00	423.11	413.33	402.67	385.33	400.44	437.33	416.44	385.33	413.04	4.78	11.89
Line # 3	417.33	409.33	398.67	408.44	414.67	408.00	397.33	406.67	404.00	390.67	381.33	392.00	412.00	402.67	392.44	402.37	5.25	8.95
Sakha 94	429.33	400.00	393.33	407.56	438.67	422.67	406.67	422.67	428.00	405.33	380.00	404.44	432.00	409.33	393.33	411.56	5.25	8.95
Line # 5	462.67	437.33	405.33	435.11	434.67	412.00	398.67	415.11	414.67	412.00	390.67	405.78	437.33	420.44	398.22	418.67	3.86	8.94
Gemmeiza 10	398.67	387.33	377.33	387.78	401.33	397.33	381.33	393.33	406.67	401.33	386.67	398.22	402.22	395.33	381.78	393.11	1.71	5.08
Line # 7	417.33	409.33	382.67	403.11	424.00	406.67	382.67	404.44	412.00	409.33	369.33	396.89	417.78	408.44	378.22	401.48	2.24	9.47
Line # 8	448.00	410.67	334.67	397.78	413.33	410.67	354.67	392.89	405.33	396.00	373.33	391.56	422.22	405.78	354.22	394.07	3.89	16.11
Gemmeiza 9	422.67	380.00	345.33	382.67	401.33	389.33	352.00	380.89	398.67	376.00	365.33	380.00	407.56	381.78	354.22	381.19	6.33	13.09
El-Nelin	452.00	426.67	354.67	411.11	414.67	405.33	372.00	397.33	408.00	392.67	375.33	392.00	424.89	408.22	367.33	400.15	3.92	13.55
Debeira	482.67	417.33	389.33	429.78	452.00	412.00	373.33	412.44	421.33	409.33	357.33	396.00	452.00	412.89	373.33	412.74	8.65	17.40
HD2501	449.33	418.67	382.67	416.89	418.67	412.00	376.00	402.22	405.33	396.00	369.33	390.22	424.44	408.89	376.00	403.11	3.66	11.41
Average	441.67	409.61	377.56	409.61	422.67	409.33	381.56	404.52	411.11	399.17	376.50	395.59	425.15	406.04	378.54	403.24	4.50	10.96

L.S.D	0.05	0.01	L.S.D	0.05	0.01
Years (Y)	3.60	4.89	Y x G	23.00	31.22
Dates (D)	3.60	4.89	D x G	18.98	25.22
Genotypes (G)	9.39	11.86	Y x D x G	57.63	71.58
Y x D	6.71	9.24			

Table 6. Average number of kernels/spike for the twelve bread wheat genotypes under three planting dates in the three seasons and over all seasons.

Genotype	2004/2005				2005/2006				2006/2007				Combined over all years			Average over all	Reduction %	
	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3		D2-D1/D1	D3-D1/D1
Sids 1	46.40	43.37	41.97	43.91	50.73	44.53	42.03	45.77	54.07	52.80	44.10	50.32	50.40	46.90	42.70	46.67	6.94	15.28
Giza 168	46.83	42.63	40.40	43.29	49.62	43.70	41.84	45.05	63.67	54.70	49.35	55.91	53.37	47.01	43.86	48.08	11.92	17.82
Line # 3	53.13	49.53	43.03	48.57	49.87	46.59	42.24	46.23	60.68	60.13	54.43	58.42	54.56	52.08	46.57	51.07	4.55	14.64
Sakha 94	45.13	44.67	47.00	45.60	49.60	45.36	42.37	45.78	60.40	52.50	45.60	52.50	51.71	47.18	44.99	47.96	8.76	13.00
Line # 5	51.20	47.13	44.97	47.77	53.23	49.83	41.60	48.22	63.33	53.70	51.00	56.01	55.92	50.22	45.86	50.67	10.19	17.99
Gemmeiza 10	49.27	47.57	43.53	46.79	48.44	44.57	42.37	45.13	65.93	51.00	48.47	55.13	54.55	47.71	44.79	49.02	12.54	17.89
Line # 7	49.60	42.90	42.2[illegible]	44.90	46.53	47.17	39.87	44.52	60.87	56.89	49.60	55.78	52.33	48.98	43.89	48.40	6.40	16.13
Line # 8	46.73	44.97	43.60	45.10	47.90	48.04	46.47	47.47	67.90	60.95	47.30	58.72	54.18	51.32	45.79	50.43	5.28	15.49
Gemmeiza 9	48.77	41.83	40.67	43.76	50.23	44.32	39.93	44.83	57.77	55.68	49.63	54.36	52.26	47.28	43.41	47.65	9.53	16.93
El-Nelin	45.23	42.97	38.20	42.13	48.37	46.27	41.66	45.43	54.35	49.96	42.50	48.94	49.32	46.40	40.79	45.50	5.92	17.30
Debeira	39.00	38.00	37.30	38.10	52.29	47.64	45.07	48.33	56.80	46.21	41.47	48.16	49.36	43.95	41.28	44.86	10.96	16.37
HD2501	46.50	39.70	36.07	40.76	49.43	42.60	40.43	44.16	58.97	51.88	43.80	51.55	51.63	44.73	40.10	45.49	13.36	22.33
Average	47.32	43.77	41.58	44.22	49.69	45.89	42.16	45.91	60.39	53.78	47.27	53.82	52.47	47.81	43.67	47.98	8.88	16.77

L.S.D	*0.05*	*0.01*	*L.S.D*	*0.05*	*0.01*
Years (Y)	*0.73*	*0.99*	*Y x G*	*1.91*	*2.49*
Dates (D)	*0.73*	*0.99*	*D x G*	*1.81*	*3.81*
Genotypes (G)	*1.01*	*1.30*	*Y x D x G*	*3.71*	*4.15*
Y x D	*1.35*	*1.87*			

Table 7. Average 1000 kernel weight (gm) for the twelve bread wheat genotypes under three planting dates in the three seasons and over all seasons.

Genotype	2004/2005				2005/2006				2006/2007				Combined over all years			Average over all	Reduction %	
	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3		D2-D1/D1	D3-D1/D1
Sids 1	45.67	41.37	39.10	41.93	45.33	44.00	40.33	43.22	49.00	45.33	40.33	44.89	46.67	43.57	39.92	43.39	6.64	14.46
Giza 168	41.53	39.33	37.60	39.49	44.33	42.67	38.33	41.78	41.00	39.00	38.67	39.56	42.29	40.33	38.20	40.27	4.63	9.67
Line # 3	38.83	37.33	36.57	37.58	43.33	41.67	37.00	40.67	40.00	39.33	38.00	39.11	40.72	39.44	37.19	39.12	3.14	8.67
Sakha 94	44.77	41.27	36.78	40.94	42.33	41.67	39.00	41.00	44.33	42.33	40.00	42.22	43.81	41.76	38.59	41.39	4.68	11.92
Line # 5	37.17	35.57	34.90	35.88	38.33	37.67	35.67	37.22	41.67	39.67	38.33	39.89	39.06	37.63	36.30	37.66	3.66	7.07
Gemmeiza 10	41.63	37.43	36.93	39.00	43.33	42.00	36.33	40.56	42.00	39.33	38.33	39.89	42.32	39.59	37.20	39.70	6.45	12.10
Line # 7	39.90	36.67	35.60	37.39	40.67	39.00	37.67	39.11	42.67	41.67	38.00	40.78	41.08	39.11	37.09	39.09	4.80	9.71
Line # 8	43.63	37.50	35.87	39.00	40.33	39.00	35.00	38.11	41.33	40.00	36.67	39.33	41.77	38.83	35.84	38.81	7.04	14.20
Gemmeiza 9	39.60	37.67	36.83	38.03	43.00	40.00	38.00	40.33	45.00	43.00	40.00	42.67	42.53	40.22	38.28	40.34	5.43	9.99
El-Nelin	42.30	38.03	37.17	39.17	42.67	40.33	37.67	40.22	45.33	42.00	39.67	42.33	43.43	40.12	38.17	40.57	7.62	12.11
Debeira	39.97	37.73	36.97	38.22	39.33	38.33	35.00	37.56	43.67	42.33	40.33	42.11	40.99	39.47	37.43	39.30	3.71	8.69
HD2501	42.30	38.80	37.57	39.56	41.67	40.67	38.33	40.22	46.67	44.00	40.33	43.67	43.54	41.16	38.74	41.15	5.47	11.02
Average	41.44	38.23	36.82	38.85	42.06	40.58	37.36	40.00	43.56	41.50	39.06	41.37	42.35	40.10	37.75	40.07	5.27	10.80

L.S.D	*0.05*	*0.01*	*L.S.D*	*0.05*	*0.01*
Years (Y)	*0.42*	*0.57*	*Y x G*	*1.15*	*1.51*
Dates (D)	*0.42*	*0.57*	*D x G*	*1.31*	*1.72*
Genotypes (G)	*0.71*	*0.95*	*Y x D x G*	*2.27*	*2.97*
Y x D	*0.75*	*0.99*			

Table 8. Average grain yield (t/ha) for the twelve bread wheat genotypes under three planting dates in the three seasons and over all seasons.

Genotype	2004/2005				2005/2006				2006/2007				Combined over all years			Average over all	Reduction %	
	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3	Average	D1	D2	D3		D2-D1/D1	D3-D1/D1
Sids 1	8.50	6.23	6.15	6.96	8.62	6.32	6.04	6.99	7.59	5.69	5.12	6.14	8.24	6.08	5.77	6.69	26.21	29.98
Giza 168	7.09	6.70	5.93	6.58	9.18	6.21	5.11	6.83	7.44	6.29	5.02	6.25	7.90	6.40	5.36	6.55	18.99	32.15
Line # 3	5.79	5.59	5.44	5.61	8.78	5.81	4.87	6.49	6.63	6.12	4.86	5.87	7.07	5.84	5.06	5.99	17.40	28.43
Sakha 94	7.63	5.83	5.06	6.17	8.08	6.43	5.16	6.56	7.55	6.67	4.85	6.35	7.75	6.31	5.02	6.36	18.58	35.23
Line # 5	5.90	5.65	5.05	5.54	9.16	6.44	5.82	7.14	7.31	5.12	5.18	5.87	7.46	5.74	5.35	6.18	23.06	28.28
Gemmeiza 10	7.48	6.63	4.48	6.19	8.48	7.05	4.61	6.71	7.41	5.07	5.07	5.85	7.79	6.25	4.72	6.25	19.77	39.41
Line # 7	7.61	6.11	5.16	6.29	7.55	6.27	4.56	6.13	7.44	6.18	4.62	6.08	7.54	6.10	4.78	6.17	19.10	36.60
Line # 8	7.42	5.61	4.29	5.78	7.91	5.66	5.27	6.28	6.79	5.08	3.93	5.27	7.37	5.45	4.49	5.77	26.05	39.08
Gemmeiza 9	7.57	5.72	4.16	5.81	8.76	6.11	4.53	6.47	7.01	6.04	4.05	5.70	7.78	5.95	4.25	5.99	23.52	45.37
El-Nelin	7.75	6.12	4.36	6.08	8.56	6.49	4.66	6.57	7.23	5.36	4.18	5.59	7.85	5.99	4.39	6.08	23.69	44.08
Debeira	7.14	5.80	4.29	5.75	7.96	6.23	5.50	6.56	5.94	5.59	4.52	5.35	7.02	5.87	4.77	5.89	16.38	32.05
HD2501	8.13	6.19	5.31	6.55	8.63	5.95	3.43	6.00	6.37	6.16	4.41	5.64	7.71	6.10	4.38	6.06	20.88	43.19
Average	7.34	6.02	4.98	6.11	8.47	6.25	4.96	6.56	7.06	5.78	4.65	5.83	7.62	6.01	4.86	6.17	21.13	36.22

L.S.D	0.05	0.01	L.S.D	0.05	0.01
Years (Y)	0.08	0.11	Y x G	0.27	0.36
Dates (D)	0.08	0.11	D x G	0.27	0.36
Genotypes (G)	0.14	0.19	Y x D x G	0.50	0.54
Y x D	0.16	0.22			

II) Genotype × environment interaction and stability analysis:

The impact of genotype by environment interaction (GxE) on the relative performance and stability of a genotype across environments is so important that it forms challenging difficulty to the breeder in developing superior cultivars broadly adapted (Eberhart and Russell, 1966). The mechanisms by which environmental stresses affect plant metabolism, thereby reducing growth and development, are still not completely understood (Pessarakli, 1994). Furthermore, (GxE) interaction has been shown to reduce progress from selection (Comstock and Moll, 1963).

An ideal cultivar would have both a high average performance over a wide range of environments plus stability. (Finlay and Wilkinson, 1963) used two values as a measure of both stability and adaptation. Cultivars with $b_i < 1.0$ were considered above average in stability and specially adapted to unfavorable environments. Cultivars with $b_i = 1.0$ were described as medium in stability and either poorly or well adapted to all environments, depending upon the cultivar mean yield.

Table 9. Joint regression analysis for some traits of the twelve genotypes under three sowing dates in the three growing seasons.

Source of variation	D.F	*Mean squares (M.S.)*				
		Days to heading	Number of spikes/ m^2	Number of kernels/ spike	1000-kw (gm)	Grain yield t /ha
Genotypes	11	33.25**	979.52**	38.83**	59.44**	0.65*
Env.+(G x Env.)	96	41.06**	628.22**	43.22**	20.65**	1.84**
a- Env.(linear)	1	3654.37**	4627.13**	3478.57**	1533.59**	152.75**
b- G x Env. (linear)	11	1.34	604.11**	9.68	4.91**	0.29
c- Pooled dev.	84	3.35**	87.99	6.72**	4.70**	0.25**
Pooled error	198	1.91	303.82	4.62	2.40	0.17

* and ** Significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table 10. Mean and estimated stability parameters of days to heading, number of spikes/ m², number of kernels/spike 1000-kernel weight and grain yield of each accession (G) of wheat genotypes over the used environments (E).

Genotype	Days to heading			Number of spikes/m²			Number of kernels/spike			1000-kernel weight (gm)			Grain yield t/ha.		
	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i	Mean	b_i	S^2d_i
Sids 1	90.07	0.920	1.196	407.41	0.997	111.569	46.67	0.718	3.283	43.39	1.377*	2.123	6.70	0.909	0.259
Giza 168	87.96	0.916	1.090	413.04	1.166	63.322	48.04	1.202	1.868	40.27	0.682	8.802**	6.55	0.965	0.160
Line # 3	90.56	1.080	1.003	402.37	0.446**	44.170	50.96	0.947	10.812*	39.12	0.730	7.658**	5.99	0.821	0.383*
Sakha 94	89.63	1.055	1.568	411.56	0.720	138.420	47.96	0.816	5.340	41.39	0.971	4.611*	6.36	0.915	0.150
Line # 5	90.15	1.009	1.741	418.67	0.934	91.987	50.67	0.970	3.961	37.66	0.823	3.591	6.20	0.880	0.588*
Gemmeiza 10	93.26	1.025	0.717	393.11	0.329*	58.977	49.02	1.060	8.045	39.70	0.991	5.065*	6.25	1.084	0.314
Line # 7	93.11	0.988	0.965	401.48	0.760	76.217	48.40	1.070	5.754	39.09	0.965	1.787	6.17	0.874	0.151
Line # 8	90.59	0.929	2.740	394.07	1.471**	162.059	50.43	1.273	9.563*	38.81	1.049	6.846**	5.77	1.031	0.158
Gemmeiza 9	91.81	1.069	13.556**	381.19	1.080	59.596	48.01	1.132	3.485	40.34	1.107	4.026	5.99	1.254	0.071
El-Nelin	87.26	1.073	1.417	400.15	1.300*	101.870	45.49	0.750	3.465	40.57	1.164*	0.748	6.04	1.219	0.059
Debeira	87.81	0.910	3.309	412.74	1.685**	109.994	44.83	0.842	21.935**	39.30	0.965	7.471**	5.89	0.851	0.203
HD2501	89.70	1.040	10.902**	403.11	1.114	37.802	45.49	1.131	3.106	41.15	1.176	3.618	6.06	1.185	0.477**
Grand mean	90.16	--	--	403.24	--	--	48.00	--	--	40.07	--	--	6.16	--	--
L.S.D 0.05	0.71	--	--	9.39	--	--	1.01	--	--	0.71	--	--	0.14	--	--

$r(\bar{x}, bi) = 0.22$ $r(\bar{x}, bi) = 0.12$ $r(\bar{x}, bi) = 0.41$ $r(\bar{x}, bi) = 0.66$ $r(\bar{x}, bi) = 0.22$

** and ** Significantly from unity for (bi) and from zero for (S^2d_i) at 0.05 and 0.01 probability levels, respectively.*

Days to heading:

The joint regression analysis of variance Table (9) revealed that the component of Env. + (G×E) was highly significant for days to heading. In addition, partitioning Env. component mean squares were highly significant, while G×E mean square was insignificant. This indicted that the environments effect were linear function but the interaction of genotypes and environments were not linear function for such trait.

The stability parameters (b_i and S^2d_i) and the mean performance ($\bar{x}$) of the individual genotypes are presented in Table (10). The regression coefficients (b_i) for Sids 1, Giza 168, line # 3, Sakha 94, Line # 5, Gemmeiza 10, line # 7, line # 8, El-Nelin and Debeira were statistically equal unity and the deviations from regression (S^2d_i) of those genotypes differed insignificantly from zero indicating that these genotypes may be considered as stable for such trait. Sids1, Giza 168, line # 7, line # 8, and Debeira were considered specially adapted to heat stress environment because the regression coefficients of these genotypes were less than one (b_i <1). However, according to (Eberhart and Russell 1966), an ideal genotype would have both a high average performance over a wide range of environments plus stability, the most desirable genotypes based on the three stability parameters ($\bar{x}$, b_i and S^2d_i) were Giza 168, Sakha 94, El-Nelin and Debeira for days to heading because they had desired performance (earliness), b_i did not differ significant from unity and least deviation from regression did not differ significantly from zero. These genotypes may have genetic systems controlling earliness and able to work consistently over environments. These results are in line with those reported by Kheiralla and Ismail (1995), Kheiralla *et. al.* (1997), Tawfelis (2006 a) and Seleem (2007).

The correlation coefficient between mean performance ($\bar{x}$) and b_i for days to heading was positive and non-significant.

Number of spikes/m^2:

The joint regression analysis of variance Table (9) revealed that the component of Env. + (G×E) was highly significant for number of spike/m^2. In addition, partitioning Env. component mean squares and G×E component mean squares were highly significant indicating that the environmental effect and the interaction of genotypes and environments were linear function for such trait.

The stability parameters (b_i and S^2d_i) and the mean performance ($\bar{x}$) of the individual genotypes are presented in Table (10). The regression coefficients (b_i) for Sids 1, Giza 168, Sakha 94, Line # 5, line # 7, Gemmiza 9 and HD 2501 were statistically equal to unity and the deviations from regression (S^2d_i) of those genotypes were also insignificantly different from zero, indicating that these genotypes may be considered as stable for such trait. Sakha 94 and Line # 5 were considered specially adapted to heat stress environment because the regression coefficients of both genotypes were insignificantly from one and less than unity (b_i <1). Otherwise, the " b_i" was insignificantly from one and more than unity (b_i >1) in Giza 168, which appeared to be more adapted to favorable environments. The most desirable genotypes based on the three stability parameters ($\bar{x}$, b_i and S^2d_i) were Giza 168, Sakha 94 and Line # 5 for number of spikes/m^2 because they had desired performance, b_i did not significantly differ from unity and least deviation from regression did not significantly differ from zero. These results are in line with those reported by Ismail (1995) and Seleem (2007)

The correlation coefficient between mean performance ($\bar{x}$) and b_i for number of spikes/m^2 was positive and non-significant.

Number of kernels/spike:

The joint regression analysis of variance in Table (9) revealed that the component of Env. + (G×E) was highly significant for number of kernels/spike. In addition, partitioning Env. component mean squares was highly significant, while G×E component mean squares was not significant. Indicated that the environments effects were linear function but the interaction of genotypes and environments was not linear function for such trait.

The stability parameters (b_i and S^2d_i) and the mean performance ($\bar{x}$) of the individual genotypes are presented in Table (10). The regression coefficients (b_i) for Sids 1, Giza 168, Sakha 94, Line # 5, Gemmeiza 10, line # 7, Gemmeiza 9, El-Nelin and HD2501 were statistically equal unity and the deviations from regression (S^2d_i) of those genotypes were also differed insignificantly from zero, indicating that these genotypes may be considered as stable for such trait. Sids 1, Sakha 94, Line # 5 and El-Nelin were considered specially adapted to heat stress because the regression coefficients of these genotypes were less than one (b_i <1). The most desirable genotypes based on the three stability parameters ($\bar{x}$, b_i and S^2d_i) were Line # 5 and Gemmiza 10 for number of kernels/spike because they had desired performance, b_i did not differ significant from unity and least deviation from regression did not significantly differ from zero. These results are in line with those reported by Kheiralla *et. al.* (1997), Tawfelis (2006 a) and Seleem (2007)

The correlation coefficient between mean performance ($\bar{x}$) and b_i for number of kernels/spike was positive and non-significant.

1000-Kernel weight (g):-

The joint regression analysis of variance Table (9) revealed that the component of Env. + (G×E) was highly significant for1000-kernel weight (gm). In addition, partitioning Env. component mean squares and G×E component mean squares were highly significant. Indicated that the environments effects were linear function but the interaction of genotypes and environments was not linear function for such trait.

The stability parameters (b_i and S^2d_i) and the mean performance ($\bar{x}$) of the individual genotypes are presented in Table (10). The regression coefficients (b_i) for Line # 5, line # 7, Gemmiza 9 and HD 2501 were statistically equal unity and the deviations from regression (S^2d_i) of those genotypes were also insignificantly different from zero, indicating that these genotypes may be considered as stable for such trait. Line # 5 and line # 7 were considered specially adapted to heat stress because the regression coefficients of these genotypes were less than one (b_i <1). Gemmeiza 9 and HD 2501 were considered specially adapted to normal sowing date because the regression coefficients of these genotypes were more than one (b_i >1).These results are in line with those reported by Tawfelis (2006 a) and Seleem (2007).

The correlation coefficient between mean performance ($\bar{x}$) and b_i for 1000-kernel weight was positive and non-significant.

Grain yield (t / ha):-

The joint regression analysis of variance in Table (9) revealed that the component of Env. + (G×E) was highly significant for grain yield. In addition, partitioning Env. component mean squares was highly significant, while G×E component mean squares was not significant. Indicated that the environments effect were linear function but the interaction of genotypes and environments were not linear function for such trait.

The stability parameters (b_i and S^2d_i) and the mean performance ($\bar{x}$) of the individual genotypes are presented in Table (10). The stability parameters revealed that the regression coefficients (b_i) values of the twelve genotypes in this study ranged from 0.82 to 1.25. The variation in (b_i) values suggested that the genotypes responded to the different environments. The regression coefficients (b_i) for Sids 1, Giza 168, Sakha 94, Gemmeiza 10, line # 7, line # 8, Gemmeiza 9, El-Nelin and Debeira were statistically equal unity and the deviations from regression (S^2d_i) of those genotypes differed insignificantly from zero, indicating that these genotypes may be considered as stable for such trait. The genotypes Sids 1, Giza 168, Sakha 94, line # 7 and Debeira were considered specially adapted to heat stress because the regression coefficients of these genotypes were less than one ($b_i < 1$). The most desirable genotypes based on the three stability parameters ($\bar{x}$, b_i and S^2d_i) were Sids 1, Giza 168, Sakha 94 and Gemmeiza 10 for grain yield because they had desired performance, b_i did not significantly differed from unity and least deviation from regression did not significantly differed from zero. These results are in line with those reported by Kheiralla and Ismail (1995), Kheiralla *et. al.* (1997) and Seleem (2007).

The correlation coefficient between mean performance ($\bar{x}$) and b_i for grain yield was positive and non-significant.

Heat susceptibility index (HSI):

The heat susceptibility indices "HSI" based on grain yield for genotypes are presented in (Table 11). These indices were used to estimate the relative stress injury (heat) because it is accounted as variation in yield potential and stress intensity. Higher values indicated higher degree of susceptibility and vice versa (Fischer and Maurer, 1978).

It is worthy to mention here that *HSI* provides a measure of tolerance based on minimization of yield loss under stress rather than non-stress yield *per se*. Therefore, the stress tolerant genotypes as defined by S values do not need to have a high yield potential. These genotypes should contain resistance (tolerance) mechanisms, which may need to be incorporated into germplasm with higher yield potential for development of high yielding stress tolerant cultivars.

Table 11. Grain yield (t/ha) under normal (D1) and late sowing (D3) dates and heat susceptibility index (HSI) of grain yield between 1st and 3rd sowing dates for twelve wheat genotypes.

Genotype	2004/2005			2005/2006			2006/2007			Over all		
	D1	D3	HSI	D1	D3	HSI	D1	D3	HSI	D1	D3	HSI
Sids 1	8.50	6.15	0.86	8.62	6.04	0.72	7.59	5.12	0.95	8.24	5.77	0.83
Giza 168	7.09	5.93	0.51	9.18	5.11	1.07	7.44	5.02	0.95	7.90	5.36	0.89
Line # 3	5.79	5.44	0.19	8.78	4.87	1.08	6.63	4.86	0.78	7.07	5.06	0.79
Sakha 94	7.63	5.06	1.05	8.08	5.16	0.87	7.55	4.85	1.05	7.75	5.02	0.97
Line # 5	5.90	5.05	0.45	9.16	5.82	0.88	7.31	5.18	0.85	7.46	5.35	0.78
Gemmeiza *10*	7.48	4.48	1.25	8.48	4.61	1.10	7.41	5.07	0.93	7.79	4.72	1.09
Line # 7	7.61	5.16	1.01	7.55	4.56	0.96	7.44	4.62	1.11	7.54	4.78	1.01
Line # 8	7.42	4.29	1.32	7.91	5.27	0.81	6.79	3.93	1.24	7.37	4.49	1.08
Gemmeiza *9*	7.57	4.16	1.41	8.76	4.53	1.17	7.01	4.05	1.24	7.78	4.25	1.25
El-Nelin	7.75	4.36	1.37	8.56	4.66	1.10	7.23	4.18	1.24	7.85	4.39	1.22
Debeira	7.14	4.29	1.25	7.96	5.50	0.75	5.94	4.52	0.70	7.02	4.77	0.89
HD2501	8.13	5.31	1.08	8.63	3.43	1.46	6.37	4.41	0.90	7.71	4.38	1.19
Grand mean	7.34	4.98	1.00	8.47	4.96	1.00	7.06	4.65	1.00	7.62	4.86	1.00

Clarke and Townley-Smith.(1984) and Fisher and Wood (1979) concluded that *HSI* was used to estimate stress injury. Low stress susceptibility (HSI < 1) is synonymous with higher stress tolerance. Results in (Table 11), indicated that the values of *HSI* in the first season ranged from (0.19 to 1.41) for Line # 3 and Gemmeiza 9 respectively, but genotypes Sids 1,Giza 168, Line # 3 and Line # 5 gave the low value of *HSI* (0.86, 0.51, 0.19 and 0.45) respectively. While in the second season the *HSI* ranged from (0.72 to 1.46) in the genotypes Sids 1 and HD 2501 but the low *HSI* were obtained by the genotypes Sids 1, Sakha 94, Line # 5, Line # 7, Line # 8 and Debeira. In the third season the values of *HSI* ranged from (0.70 to 1.24) of the genotypes Debeira and Gemmeiza 9, respectively, while Sids 1,Giza 168, Line # 3 , Line # 5, Gemmeiza 9, Debeira and HD 2501 gave the low value of *HSI* (0.95, 0.95, 0.78, 0.85, 0.93, 0.70 and 0.90) for seven genotypes respectively. On the other hand the *HSI* over all three years ranged from 0.78 for Line # 5, to 1.25 for genotypes Gemmeiza 9. The genotypes Sids 1,Giza 168, Line # 3 , Sakha 94, Line # 5 and Debeira produced low heat susceptibility index (0.83, 0.89, 0.79, 0.97, 0.78 and 0.89) and grain yields of 5.77, 5.36, 5.06, 5.02, 5.35 and 4.77 t/ha for the six genotypes, respectively. A superior genotypes for heat tolerance would give the least values of heat susceptibility index (HSI < 1) and high grain yield under heat stress, these genotype were Sids 1,Giza 168, Line # 3 , Sakha 94 , Line # 5 and Debeira and gave grain yield 5.77, 5.36, 5.06, 5.02, 5.35 and 4.77 t/ha under heat stress. Therefore, these genotypes could be considered as promising genotypes in breading wheat program for heat stress.

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أداء و قياسات الثبات لبعض التراكيب الوراثية من قمح الخبز تحت ظروف بيئية مختلفة في مصر العليا

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أجري هذا البحث في محطة البحوث الزراعية بشندويل – مركز البحوث الزراعية – مصر خلال المواسم الزراعية الثلاثة ٢٠٠٤/٢٠٠٥ ، ٢٠٠٥/٢٠٠٦، ٢٠٠٦/٢٠٠٧ وكان الهدف من الدراسة تقييم بعض التراكيب الوراثية لقمح الخبز تحت ثلاثة مواعيد زراعة وكذلك تأثير الزراعة المتأخرة والتعرض للحرارة علي المحصول ومكوناته وبعض الصفات الأخرى وأيضاً التفاعل بين التركيب الوراثي والبيئة وتحليل الثبات ومعامل الحساسية للحرارة.

أستخدم في التجربة ١٢ تركيب وراثي من قمح الخبز ذات اختلافات وراثية واسعة بعضها أصناف محلية وأخري مستوردة، زرعت هذه الأصناف والسلالات في ثلاثة مواعيد زراعية، الموصي به (٢٥ نوفمبر)، المتأخر (١٠ , ٢٥ ديسمبر) خلال الثلاث مواسم، باستخدام تصميم قطاعات كاملة العشوائية مع ثلاثة مكررات في كل ميعاد زراعة.

وقد تم دراسة عدد الأيام من الزراعة حتى التزهير ، عدد السنابل/م٢، عدد حبوب السنبلة، وزن الألف حبة ومحصول الحبوب طن/هكتار. وقد أظهرت النتائج استجابات مختلفة للتراكيب الوراثية من بيئة إلي أخري. كما أدت الزراعة في ميعاد متأخر إلي نقص في عدد الأيام من الزراعة إلي التزهير، عدد السنابل/م٢، عدد حبوب السنبلة، وزن الألف حبة ومحصول الحبوب في الميعاد الثاني والثالث بمقدار (٥,٤١ ، ١٢,١٥ ٪) و (٤,٤٥ ، ١٠,٩٠ ٪) و (٨,٨٨ ، ١٦,٧٧ ٪) و (٥,٢١، ١٠,٨٠ ٪) و (٢١,١٤ ، ٣٦,٢٠ ٪) بالمقارنة بالزراعة في الميعاد الأول علي الترتيب. تشير هذه النتائج إلى أن التراكيب الوراثية تباينت في استجابتها للظروف البيئية مما يوضح أهمية تقييم التراكيب الوراثية تحت بيئات مختلفة بغرض تحديد أفضل التراكيب الوراثية لهذه البيئات.

أظهر تحليل تباين الانحدار فروقا عالية المعنوية بين التراكيب الوراثيـــة لكـــل الـــصفات المدروسة. علاوة على ذلك كان لمكون التفاعل بين البيئة والصنف x البيئة ذو تأثيرعالى المعنويـــة في الصفات تحت الدراسة ، في حين كان لمكون (الصنف x البيئة) تأثير غير معنوي لكل الـــصفات عدا عدد السنابل/م^{2} و وزن الألف حبة، وكان الجزء المتبقي معنوياً لصفات عدد الأيام حتى طـــرد السنابل، عدد الحبوب/سنبله، وزن الألف حبة ومحصول الحبوب.

أظهرت القياسات الوراثية لصفة وزن محصول الحبوب إلى أن الصنف ســـدس ١، جيـــزة ١٦٨، سخا ٩٤، سلالة رقم ٧ والصنف دبيرا هم الأكثر ثباتا في بيئات الإجهاد الحـــراري وهـــذه التراكيب الوراثية يمكن استخدامها في برامج التربية لأنها ذات قدرة محصولية عالية وعلي درجـــة

عالية من الثبات. أكدت النتائج ضرورة استخدام كل من متوسط أداء التركيب الوراثي ومقياس الثبات الخاصة به معا للتوصية باستخدام أي تركيب وراثي في بيئات مختلفة.

و أظهرت النتائج أنه توجد ستة تراكيب وراثية هي سدس١ , جيزة ١٦٨ , سلالة رقم ٣, سخا ٩٤, سلالة رقم ٥ والصنف المستورد ديبيرا متحملة للحرارة (الزراعة المتأخرة) وأعطت قيمة لمعامل الحساسية للحرارة أقل من الواحد الصحيح وذات محصول عالي تحت الزراعة المتأخرة.