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VARIABILITY AND HERITABILITY OF SOME WHEAT TRAITS UNDER IRRIGATION AND WATER STRESS CONDITIONS

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ABSTRACT

The experiments reported herein were carried out at the Agricultural Experiment and Research Station, Faculty of Agriculture, Cairo University, during the two successive seasons 2006/2007 and 2007/2008. Twenty two bread wheat genotypes (Triticum aestivum L.) were evaluated under irrigation and water stress conditions. The combined analysis of variance revealed that mean squares due to years, genotypes and genotype x years were significant ($P < 0.01$) for the studied traits across irrigation and water stress conditions. However, years were significant ($P < 0.05$) for No. of spikes/ m^2 across the two irrigation regimes. On the other hand, years were insignificant for spike length under water stress conditions. Also genotypes x years were insignificant for no. of spikes / m^2 under irrigation conditions. The contribution of variance due to genotypes (σ^2_g) to the total variance was weak, except for plant height under non-irrigation conditions (σ^2_g= 19.77%) and spike length under irrigation conditions (σ^2_g= 17.29%). Highest estimates of broad sense heritability (h^2_b) exhibited by plant height under non-irrigation conditions indicated that selection for this trait could be highly effective. However, h^2_b was low for No. of spikes/m^2, grain weight/spike and grain yield under the two irrigation regimes. The estimates of phenotypic (PCV) and genotypic (GCV) coefficients of variation were higher for grain yield, grains weight/spike and plant height than the other studied traits under both irrigation regimes. However, spikelets/spike exhibited the lowest value for PCV and GCV under both irrigation regimes.

Key words: ***Triticum aestivum, Heritability in broad sense, Phenotypic and genotypic coefficient of variability, Yield and its components.***

INTRODUCRTION

Wheat is the world's most important and most widely grown cereal crop. Its importance is derived from many properties and uses of its grains, which makes it staple food for more than one third of world's population (Poehlman 1987).

One of the most important genetic parameters of metric traits is the heritability, since it almost enters into every formula connected with breeding methods and so it contributes in making many applications concerning the techniques used in the genetic improvement of the plants.

Several investigations conducted at the Oklahoma Agricultural Experiment station dealing with heritability estimates in wheat were summarized by Smith (1976). Heritabilities for yield components were usually higher than for grain yield, with heritabilities for kernel weight usually the highest. Heritability estimates for yield and its components reported by Chowdhry *et al* (1976), Weibel (1956), Kronstad and Foote

(1964) and Johnson *et al* (1966) were in general agreement with those reported by Smith (1976).

High heritability values were also reported by Johnson *et al* (1966) for plant height, maturity and grain weight in winter wheat. It is noteworthy that the heritability estimates in their study tended to be high for those characters exhibiting wide differences between the studied genotypes. Also, Hassan (2002) reported that under saline soil, broad-sense heritability for plant height ranged from 53.15 to 84.84%, while the range for number of tillers/plant was from 51.71, to 67.1%. Similar results were found by Hassan and Afiah (2002) and they mentioned that all characters had high values of broad-sense heritability. Slight differences were noticed between phenotypic (P.C.V.) and genotypic (G.C.V.) coefficients of variability suggesting a small effect of environmental factors on these characters.

May and Van Sanford (1992) in two populations of soft red winter wheat reported that heritability of heading date was 67.0 % in population I and 81.0 % in population 2; their results were intermediate in magnitude as compared to those reported previously (Johnson *et al* 1966).

However, moderate heritability estimates were obtained under water stress by Subhani and Chowdhry (2000) and Subhani *et al.* (2000) for days to heading, El-Borhamy (2000) for days to maturity and plant height and Riaz and Chowdhry (2003) for 1000-grain weight. Meanwhile, Hassani *et al.* (2005) obtained a moderate heritability under normal conditions for days to heading, days to maturity, plant height, 1000-grain weight and grain yield.

Mahdy (1988) reported that high genotypic coefficient of variability was observed for no. of grains/spike (27.2%), grain yield/plant (26.3%), spike weight (25.7%) and no. of spikes/plant (20.2%). The magnitude of the genetic variability have a considerable effect on early selection generations. Greater response to selection can be expected from populations, having greater phenotypic and genotypic variances.

Tolba (2000) found that the highest P.C.V. values were observed for grain yield/plant, followed by grain weight/spike and no. of spikes/plant. Also, G.C.V. exhibited the same trend. This variability could be due to the genetic make-up and environmental effects. These results were in agreement with those obtained by Ehdaie and Waines (1989) and Hanna *et al* (1996) who reported that G.C.V. values ranged from 2.29 to 6.57 % as compared to P.C.V. which ranged from 11.78 to 29.67 % for grain yield/plant.

Several investigators suggested that the knowledge of genetic variability is helpful in selecting a suitable plant (Fischer and Maurer 1978, Winter *et al* 1988, Abd El-Moneim 1993, Hassan 1996 and Afiah *et al* 1999).

The present investigation was designed to study the genetic variability, heritability and phenotypic and genotypic coefficients of variability in twenty two bread wheat genotypes for grain yield and its components under water-stress and non-stress conditions.

MATERIALS AND METHODS

Genetic materials and its cultural practices

The present work was performed at the Agricultural Experiment and Research Station, Faculty of Agriculture, Cairo University, Giza during two successive seasons 2006/2007 and 2007/2008. Twenty two bread wheat genotypes were chosen for this study based on their differences in yield performance under irrigated and water stressed environments. The pedigree and origin of the studied genotypes are listed in Table (1). All genotypes were planted in a randomized complete block design with four replications and grown under irrigated and water stressed environments. Irrigated plots were watered at planting, tillering, jointing, flowering and grain filling stages. Non-irrigated plots received water only at planting. Sowing was done in the third week of November in all experiments of the two seasons. Plots consisted of four rows (3 m long and 20 cm apart).

Ten plants were randomly chosen from each plot to measure the plant height, spike length, spikelets/spike and grain weight/spike. The grain yield was measured from all plants of the two central rows of each plot at crop maturity.

Biometrical procedures

Normality distributions in each trait were checked out by the Wilk Shapiro test (Neter *et al* 1996). A combined analysis of variance was conducted for the two seasons according to Gomez and Gomez (1984). Homogeneity test of variances were performed according to procedures reported by Gomez and Gomez (1984). Data were statistically analyzed using ANOVA and LSD value was employed for the mean comparisons in the MSTAT-C software package (Freed *et al* 1989).

Heritability in broad sense (h^2_b)

Heritability in broad sense (h^2_b) was estimated using the components of variation according to the formulae outlined by Weber and Moorthy (1952) as follows:

$$h^2_b = (\sigma^2_g/\sigma^2_{ph}) \text{ X } 100$$

Where: σ^2_{ph} and σ^2_g are the phenotypic and genotypic variances, respectively.

Phenotypic (PCV) and genotypic (GCV) coefficients of variability

Phenotypic (PCV) and genotypic (GCV) coefficients of variation for the studied characters were calculated as described by Burton (1952) using the following formulae:

$$PCV = \frac{\sigma_{ph}}{\bar{x}}.100 \quad GCV = \frac{\sigma_g}{\bar{x}}.100$$

Where: $\bar{x}$ is the general mean, σ_{ph} and σ_g are the phenotypic and genotypic standard deviations, respectively.

Table 1. Names, pedigrees and origins of the studied wheat genotypes.

No.	Genotypes	Pedigree	Origin*
1	Line 35	KUZ*2/SOW//KAUZ GRG 905-13Y-010M-0Y-0HTY	Egypt
2	Line 37	FOW-2/SP8036	Sudan
3	Line 38	MNCH 3*BCN CMBW 90 YS 756-0T0PM-14Y-010M-010M-010Y-5M	Egypt
4	Line 41	22SAWSN-77	Sudan
5	Line 44	TEVEE"S"/TDINA	Sudan
6	Giza 168	Mrl / Buc // Seri CM 93046 – 8 M – OY – OM-ZY- OB-OGZ	Egypt
7	Line 46	KAUZ//KAUZ/STAR	Sudan
8	Line 47	BARBETTI	Sudan
9	Line 48	KUZ*2/BOW//KAUZ	Sudan
10	Line 49	PC970/G 155//Bow"s"	Sudan
11	Line 54	22SAWSN-27	Sudan
12	Line 55	1YSN	Yemen
13	Line 56	2 TSN	Yemen
14	Line 59	5 YSN	Yemen
15	Line 65	12 YSN	Yemen
16	Line 68	15 YSN	Yemen
17	Line New Vally	Not Available	Yemen
18	V(92/17)	Not Available	Yemen
19	V(99/17)	Not Available	Yemen
20	Gemmiza 1	Inia/RL 4220//7C/3/YRCM 15430-25-55-05	Egypt
21	Sakha 8	G. 155/7C//Inia/3/Nielain	Egypt
22	Sahel 1	CAZO/KAUZ//KAUZ	Egypt

*Source: Plant Genetic Resources Research Department (Bahteem Gene Bank), FCRI, ARC-Egypt

RESULTS AND DISCUSSION

Analysis of variance and variance components

The combined analysis of variance (ANOVA) across seasons is shown in Table (2). The main effects due to years, genotypes and genotypes x years were highly significant ($P < 0.01$) for all studied traits under both enviroments. However, years was significant ($P < 0.05$) for no. of spikes / m^2 under water-stress and non-stress conditions (Table 2). On the other hand, variance due to years was insignificant for spike length under non-irrigated conditions. Also, genotypes x years were insignificant for no. of spikes/m^2 under irrigation conditions. Same results for grain yield were obtained by Menshawy (2007).

Estimates of variance components due to genotypes and their interactions with years for the studied traits under water-stress and non-stress are presented in Table (3). Results indicates that σ^2_y component accounted for 70.90% of the total variation for plant height, followed by grain weight/spike which accounted for 48.12% of the total variation. While, for grain yield the σ^2_y accounted for 47.53%. However, the high value of σ^2_y which was obtained under each irrigation regime indicated the strong influence of years on yield performance of wheat genotypes. The small contribution for σ^2_{gy} was high for spike length, grain weight /spike and grain yield under both environments, indicated that the genotypes were more consistent over years. The contribution of variance due to genotypes (σ^2_g) to the total variance was weak except for plant height under

Table 2. Combined ANOVA table for the studied traits of the 22 wheat genotypes tested across two seasons under irrigated and water-stressed environments.

S.O.V.	df	Plant Height (cm.)	Spike Length (cm.)	Spikelets /spike	No. of spikes/ m^2	Grains weight/spike (g.)	Grain Yield ardab/ fed.
Water-stress							
Years (Y)	1	16208.64 **	6.25	48.09 **	354619.32 *	63.35 **	3451.07 **
Reps/year	6	39.38	2.74	1.97	57841.30	1.98	117.02
Genotypes (G)	21	447.27 **	8.60 **	7.91 **	20397.27 **	2.60 **	139.78 **
G x Y	21	37.321 **	5.37 **	7.29 **	20349.20 **	2.14 **	122.43 **
Error	126	19.80	0.77	1.63	3860.33	0.21	11.98
Non-stress							
Years (Y)	1	24205.09 **	35.01 **	77.78 **	129023.74 *	148.40 **	8395.04 **
Reps/year	6	83.65	3.26	6.90	17338.26	2.46	130.53
Genotypes (G)	21	371.14 **	21.28 **	13.60 **	20708.15 **	5.05 **	283.02 **
G x Y	21	212.35 **	9.68 **	6.30 **	13625.264	4.04 **	226.49 **
Error	126	28.93	1.45	1.68	9279.27	0.50	28.04

water stress conditions (σ^2_g= 19.77%) and spike length under non-stress conditions (27.68%). The results of low σ^2_g indicated that these traits have a large environmental influence, so they need to be tested over more locations and years (Hohls 1995).

Mean performance

Means of different studied traits of 22 wheat genotypes under irrigation and water-stress conditions are presented in Table 4. Water stress caused a reduction in all studied traits. The highest reduction was exhibited by grain yield (50.17%) followed by spike length (17.04%), while the lowest reduction was shown by spikelets/spike (9.84%). Reduction due to water stress was also reported by previous investigators (El-Ganbeehy 2001, Farhat 2005 and Al-Naggar *et al* 2007). Data in Table (4) indicated that the shortest lines were L.R. 38 (70.50 cm.) and L.R. 65 under water-stress and non-stress conditions, respectively. However the lowest and highest spike length were exhibited by L.R. 48 and L.R. 35 under both enviroments. On the other hand, Giza 168 produced the lowest grain yield under the two irrigation systems, while the highest grain yield under stress was V-92/17 (4.96 t /ha) followed by L.R. 65 (4.93 t /ha), V-99/17 (4.93 t /ha), L.R.59 (4.80 t /ha), L.R.54 (4.79 t /ha) and L.R. 49 (4.44 t /ha).

Heritability and coefficients of variation

The estimates of broad-sense heritability, phenotypic (PCV) and genotypic (GCV) coefficients of variation are presented in Table (5).

Table 3. Estimates of variance components due to years, genotypes and their interactions for the studied traits under irrigated and water-stressed enviroments.

Estimate	Plant Height (cm.)		Spike Length (cm.)		Spikelets /spike		No. of spikes/m^2		Grains weight/spike (g.)		Grain Yield ardab/fed.	
	Estimate	var(%)*	Estimate	var(%)	Estimate	var(%)	Estimate	var(%)	Estimate	var(%)	Estimate	Var (%)
	Water-stress											
σ^2_y	183.77	70.90	0.01	0.49	0.46	12.92	3798.52	32.23	0.70	48.12	37.83	47.53
σ^2_g	51.24	19.77	0.40	17.29	0.08	2.16	6.01	0.05	0.06	3.96	2.17	2.73
σ^2_{gy}	4.38	1.69	1.15	49.12	1.41	39.41	4122.22	34.97	0.48	33.40	27.61	34.69
σ^2_e	19.80	7.64	0.77	33.10	1.63	45.51	3860.33	32.75	0.21	14.53	11.99	15.06
	Non-stress											
σ^2_y	272.64	74.23	0.29	5.49	0.81	17.81	1311.35	10.44	1.64	52.11	92.82	52.28
σ^2_g	19.85	5.40	1.45	27.68	0.91	20.01	885.36	7.05	0.13	4.01	7.07	3.98
σ^2_{gy}	45.86	12.48	2.06	39.26	1.16	25.33	1086.50	8.65	0.89	28.15	49.62	27.95
σ^2_e	28.93	7.88	1.45	27.57	1.68	36.86	9279.27	73.86	0.50	15.72	28.04	15.79

Contribution to total variation (%)

Table 4. Mean performance of studied traits for wheat genotypes under water-stress (N) and non-stress (I) conditions, and their reductions (Red %) (data across combined across two seasons).

Genotypes	Plant height (cm.)			Spike length (cm.)			Spikelets/spike			Spikes/m^2			Grains weight/ spike (g)			Grain yield ardab/fed		
	N	I	Red. %	N	I	Red. %	N	I	Red. %	N	I	Red. %	N	I	Red. %	N	I	Red. %
L.R. 35	89.50	97.38	8.09	11.31	14.88	23.95	20.00	23.00	13.04	469.60	570.39	17.67	3.03	3.35	9.64	4.07	19.28	40.89
L.R. 37	77.50	84.50	8.28	10.63	14.31	25.77	18.25	22.38	18.44	464.43	498.98	6.92	2.72	2.95	7.96	3.25	16.31	44.21
L.R. 38	70.50	86.25	18.26	9.75	11.38	14.29	19.50	21.50	9.30	432.25	539.13	19.82	2.54	2.62	3.05	2.78	13.85	43.79
L.R. 41	86.88	98.50	11.80	9.50	13.00	26.92	21.50	22.88	6.01	405.55	521.23	22.19	2.39	2.66	10.11	2.38	14.13	52.83
L.R. 44	81.00	97.38	16.82	8.50	10.38	18.07	21.38	25.88	17.39	379.00	497.44	23.81	2.52	3.15	19.97	2.73	17.80	57.05
Giza 168	73.00	84.25	13.35	9.00	10.44	13.78	20.13	22.13	9.04	335.63	518.12	35.22	1.87	2.02	7.67	0.97	9.34	70.92
L.R. 46	82.38	96.88	14.97	10.44	14.13	26.10	22.00	24.38	9.74	387.09	489.03	20.84	2.15	2.39	9.96	1.74	12.11	59.78
L.R. 47	86.00	97.13	11.45	11.31	13.88	18.46	21.00	22.88	8.20	364.94	524.91	30.47	2.03	2.61	22.38	1.41	13.76	71.32
L.R 48	90.00	102.63	12.30	7.81	9.38	16.66	20.13	23.88	15.71	357.82	474.25	24.55	1.85	3.06	39.71	1.30	16.03	77.30
L.R. 49	77.50	88.00	11.93	11.00	11.88	7.37	19.50	21.63	9.83	449.62	542.78	17.16	3.47	3.54	1.98	4.44	20.20	38.47
L.R. 54	82.13	90.00	8.75	9.13	10.63	14.12	19.63	21.13	7.10	480.94	520.84	7.66	3.00	3.30	9.09	4.79	16.70	19.71
L.R. 55	72.75	81.88	11.15	8.38	9.44	11.26	20.25	21.25	4.71	384.48	526.65	27.00	2.13	2.97	28.05	1.70	16.42	71.02
L.R. 56	80.00	91.00	12.09	9.94	10.94	9.14	20.00	21.38	6.43	377.22	513.04	26.47	2.10	2.20	4.55	1.59	10.68	58.33
L.R. 59	77.00	85.88	10.33	9.94	13.00	23.55	21.50	22.88	6.01	481.34	489.85	1.74	3.30	3.55	7.15	4.80	15.22	11.70
L.R. 65	77.38	81.50	5.06	8.44	10.81	21.96	19.50	21.50	9.30	411.00	432.00	4.86	3.72	4.16	10.55	4.93	18.02	23.40
L.R. 68	85.38	93.50	8.69	9.50	11.50	17.39	20.75	23.75	12.63	415.68	454.78	8.60	2.66	3.33	20.29	3.09	19.14	54.80
N Vally	86.00	95.13	9.59	8.50	10.25	17.07	18.38	20.75	11.45	426.87	470.15	9.21	3.10	4.45	30.35	4.26	18.30	34.82
V(92/17)	83.25	91.75	9.26	10.19	10.56	3.55	19.75	22.25	11.24	457.61	490.25	6.66	3.36	4.43	24.15	4.96	16.17	14.12
V(99/17)	83.75	90.88	7.84	10.00	12.19	17.95	19.50	21.25	8.24	421.51	465.17	9.39	3.35	3.31	-1.15	4.93	16.20	14.79
Gem 1	103.88	104.50	0.59	7.94	10.00	20.62	19.75	22.13	10.73	359.71	388.55	7.42	3.06	4.26	28.08	4.16	14.86	21.59
Sakha 8	91.88	103.88	11.55	8.88	10.75	17.44	19.88	21.25	6.47	424.07	530.92	20.13	2.64	3.06	13.89	3.02	17.12	50.62
Sahel 1	82.88	92.88	10.77	9.50	10.50	9.52	19.50	20.63	5.45	463.91	522.96	11.29	3.05	4.22	27.79	4.12	17.35	33.50
Mean	82.75	92.53	10.59	9.53	11.55	17.04	20.08	22.30	9.84	415.92	499.15	16.32	2.74	3.26	15.34	3.25	15.86	43.86
L.S.D. 5%	4.45	5.38	------	0.88	1.20	------	1.28	1.30	------	62.17	96.38	------	0.46	0.70	------	1.23	5.29	------

Table 5. Estimates of broad sense heritability (h^2_b), phenotypic (P.C.V.) and genotypic (G.C.V.) coefficients of variation for the studied traits under water-stress and non-stress conditions (data across combined across two seasons).

Estimates	Plant height	Spike Length	Spikelets /spike	Spikes/ m^2	Grains weight/spike	Grain Yield ardab/ fed
Water-stress						
h^2_b	67.94	17.38	2.48	0.08	7.63	5.19
GCV %	8.65	6.67	1.39	0.59	8.72	16.18
PCV %	10.50	16.01	8.80	21.49	31.55	71.02
Non-stress						
h^2_b	20.97	29.29	24.34	7.87	8.37	8.34
GCV %	4.82	10.43	4.28	5.96	10.90	14.88
PCV %	10.52	19.25	8.68	21.25	37.66	51.52

The highest estimates of broad-sense heritability (h^2_b) were exhibited by plant height and spike length under water-stress conditions, while the highest values of h^2_b under irrigation conditions were obtained by plant height, spike length and spikelets/spike, indicating that selection for these traits could be highly effective. However, h^2_b was low for no. of spikes/m^2, grain weight/spike and grain yield under the two irrigated systems. These low values of heritability suggested that selection for high yield must be performed on yield components not on yield *per se*. In the context, Johnson *et al* (1955) suggested that heritability along with genetic gain are usually more useful than the heritability value alone in predicting the resultant effect for selecting the best individuals. The present results are in harmony with those obtained by Al-Naggar *et al* (2007). Salem *et al* (1983) reported that magnitude of heritability percentage appeared to be affected by four relevant factors: (1) methods of estimation, (2) cross and generation, (3) nature of measured trait and (4) the magnitude of environmental variation. Also, Weber and Moorthy (1952) found that heritability for grain yield in the wheat crosses was very erratic and in average near zero. Such results indicate the need for better control of environmental variance and/or genotypic-environmental interaction.

Estimates of phenotypic (P.C.V.) and genotypic (G.C.V.) coefficient of variability are presented in Table (5). The x P.C.V. and x G.C.V. may serve as a reference point for breeders when they try to detect genotypic differences with respect to plant traits and also make the selection of forms with valuable genotypes much more effective. The estimates of P.C.V. and G.C.V.in this study appeared to be higher for grain yield, grains weight/spike and plant height than the other traits under both irrigation and water-stress conditions.

However, spikelets/spike exhibited low value for P.C.V. and G.C.V. under both irrigation regimes, revealing that environmental effects were of great importance for this trait. Both P.C.V. and GCV estimates were generally higher under water stress than under irrigation conditions for plant height and grain yield. These results are in agreement with those obtained by Dawla (1984), Ehdaie and Waines (1989) and Tolba (2000). The later found that P.C.V. and G.C.V. for plant height were 8.60 and 8.22%, respectively. Also, Mahdy (1988) found low values of P.C.V. (8.90%) and G.C.V. (8.50%) for plant height.

REFERENCES

Abd El-Moneim, A. M. (1993). Variability and heritability of some wheat traits under low rain-fed conditions in North Sinai. Zagazig J. Agric. Res. 20:1727-1737.

Al-Naggar, A.M., M.A. Moustafa, M.M. Atta and M.T. Shehab-Eldeen (2007). Gene action of earliness and grain filling in bread wheat under two irrigation regimes. Egypt J. Plant Breed. 11(3):1-22.

Burton, G. W. (1952). Quantitative inheritance in grasses. In Proc. of the 6^{th} International Grassland Congress., 277-283.

Chowdhry, A. R., M. Saleem and K. Alam (1976). Relation between flag leaf, yield of grain and yield components in wheat. Expl. Agric. 12:411-415.

Dawla, N. F. (1984). Phenotypic and genotypic variability in a *Triticum astivum* L. wheat cross. Annals of Agric. Sci. Moshtohor 21:47-53.

Ehdaie, B. and J. G. Waines (1989). Genetic variation, heritability and path analysis in landraces of bread wheat from southwestern Iran. Euphytica 41:183-190.

El-Borhamy, H. S. (2000). Genetic studies on some quantitative characters in bread wheat (*Triticum aestivum* L.). Ph D. Thesis, Fac. of Agric., Zagazig univ. (Benha Branch), 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.

Farhat, W. Z. E. (2005). Genetically studies on drought tolerance in bread wheat. M.Sc. Thesis, Fac. of Agric., Tanta University, Egypt.

Fischer, R. A. and R. Maurer (1978). Drought resistance in spring wheat cultivars. 1- Grain yield response. Aust. J. Agric. Res. 29:897-912.

Freed, R., S. P. Einensmith, S . Gutez, D . Reicosky, V. W. Smail and P. Wolberg (1989). User's Guide to MSTAT-C Analysis of Agronomic Research Experiments. Michigan State University, East Lansing , USA.

Gomez, K. A. and A. A. Gomez (1984). Statistical Procedure for Agricultural Research. 2^{nd} edition John Wily and Sons Inc. New York.

Hanna, N. S., S. R. S. Sabry and M. M. Abdel-Aleem (1996). Identification of high grain yield bread wheat varieties. Annals Agric. Sci., Ain Shms Univ. 41(2):671-681.

Hassan, A. I. A. (2002). Gene action and heritability estimates of F_3 wheat families under saline conditions at Ras Sudr. Zagazig J. Agric. Res. 29(2):405-420.

Hassan, A. I. A., and S. A. N. Afiah. (2002). Association, variation, heritability and path coefficient analysis of five F_3 wheat families under saline conditions. J. Agric. Sci. Mansoura Univ. 27(2):739-749.

Hassan, I. A. H. (1996). Estimation of some characters related to salt tolerance in wheat. Ph. D. Thesis, Fac.. Agric, Zagazig Univ. Egypt.

Hassani, M., G. Saeidi and A. Rezai (2005). Estimation of genetic parameters and combining ability for yield and yield components in bread wheat. J. of Sci. Techn. Of Agric. and Natural Res. 9:(1) 157-171.

Hohls, T. (1995). Analysis of genotype-environment interactions. Afr. J. Sci. 91:121-124.

Johnson, H. W., H. F. Robinson and R. E. Comstock (1955). Estimates of genetic and environmental variability in soybeans. Agron. J. 47:413-318.

Johnson, V. A., K. J. Biever, A. Haunold and J. W. Schmidt (1966). Inheritance of plant height, yield of grain, and other plant and seed characteristics in a cross of hard red winter wheat. Crop Sci. 6:336-338.

Kronstad, W. E. and W. H. Foote (1964). General and specific combining ability estimates in winter wheat. Crop Sci. 4:616-619.

Mahdy, E.E. (1988). The efficiency of some selection procedures in wheat, (*Triticum aestivum* L.). Assiut J. of Agri. Sci. 19:291-299.

May, L. and D. A. Van Sanford (1992). Selection for early heading and correlated response in maturity of soft red winter wheat. Crop Sci. 32:47-51.

Menshawy, A.M.M. (2007). Evaluation of some early bread wheat genotypes under different sowing dates:1. Earliness characters. Egypt J. Plant Breed. 11(1):25-40.

Neter, J., M. Khutner, C. Nachtsheim and W. Wasserman (1996). Applied Linear Statistical Models . 4th Ed. Irwin Series. Time Mirror. Education Group. 111-121.

Poehlman, J. W. (1987). Breeding Field Crops 3rd edition. AVI Publishing Company Inc. Wastport, Comm, U.S.A. 724 pp.

Riaz, R. and M. A. Chowdhry (2003). Estimation of variation and heritability of some physio-morphic traits of wheat under drought conditions. Aust. J. of Plant Sci., 2:748-755.

Salem, A. H., G. A. Morshed, M. M. El-Ashry and A. A. Ageez. (1983). Heritability estimates of yield and its attributes of some wheat crosses in sequent generations. Annals of Agric. Sc., Moshtohor, 19:13-23.

Smith, E. L. (1976). The genetics of wheat architecture. Ann. Oklahoma Acad. Sci. 6:117-132.

Subhani, G. M. and M. A. Chowdhry (2000). Genetic studies in bread wheat under irrigated and drought stress conditions. Pak. J. Sci., 3:1793-1798.

Subhani, G. M., M. A. Chowdhry and S. M. M. Gilani (2000). Estimates of genetic variability parameters and regression analysis in bread wheat under irrigated and drought stress conditions. Pak. J. Bio. Sci., 3:652-656.

Tolba, M. A. (2000). Evaluation of different bread wheat lines in the F_6 and F_7 generation for grain yield and its attributes. J. Agric. Sci. Mansoura Univ. 25(10):6051-6063.

Weber, C. R. and B. R. Moorthy (1952). Heritable and non-heritable relationships and variability of oil content and agronomic characters in the F_2 generation of soybean crosses. Agron. J. 44:202-209.

Weibel, D. E. (1956). Inheritance of quantitative characters in wheat. Iowa St. Col. J. Sci. 30:450-451.

Winter, S. R., J. T. Musick and K. B. Porter (1988). Evaluation of screening techniques for breeding drought resistant winter wheat. Crop Sci. 28:512-516.

التباين وكفاءة التوريث لبعض صفات القمح تحت ظروف الإجهاد وعدم الإجهاد المائي

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أجريت هذه الدراسة في محطة البحوث و التجارب الزراعية – كلية الزراعة – جامعة القاهرة خلال موسمين متتالين ابتداء من موسم ٢٠٠٦/٢٠٠٧ حيث تم تقييم اثنان وعشرون تركيباً وراثياً من القمح تحت ظروف الري الكامل والإجهاد المائي.

اظهر تحليل التباين المجمع عبر السنوات أن مكونات التباين الراجعة إلى السنوات و التراكيب الوراثية و التفاعل بين التراكيب الوراثية و السنوات كانت معنوية جدا لجميع الصفات موضع الدراسة تحت كلاً من نظامي الري، بينما كانت السنوات معنوية فقط لصفة عدد السنابل /م٢ تحت ظروف كلا النظامين. على العكس كانت السنوات غير معنوية لصفة طول السنبلة تحت ظروف الإجهاد المائي، ظهرت نفس النتيجة أيضا مع التفاعل بين التراكيب الوراثية و السنوات لصفة عدد السنابل/م٢ تحت ظروف الري الكامل.

كانت مكونات التباين الراجعة الى التراكيب الوراثية (σ^2_g) منخفضة فيما عدا صفة طول النبات تحت ظروف الإجهاد المائي و كذلك صفة طول السنبلة تحت ظروف الري الكامل.

كانت كفاءة التوريث في المعنى العام لصفات طول النبات و طول السنبلة عالية تحت ظروف الإجهاد المائي. على العكس كانت كفاءة التوريث في المعنى العام منخفضة لصفة عدد السنابل/م٢ و وزن حبوب السنبلة و محصول الحبوب تحت كلاً من نظامي الري.

كانت قيم معامل الاختلاف المظهري والوراثي عالية لصفات طول النبات ووزن حبوب السنبلة و محصول الحبوب مقارنة بباقي الصفات تحت كلاً من نظامي الري ، بينما كانت قيم معامل الاختلاف المظهري والوراثي منخفضة لصفة عدد السنيبلات / سنبلة تحت ظروف كلا النظامين من الري.