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ESTIMATES OF STABILITY PARAMETERS AND PATH ANALYSIS FOR SOME WHEAT GENOTYPES UNDER DIFFERENT ENVIRONMENTS

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ABSTRACT

Ten wheat genotypes (*Triticum aestivum* L.) were evaluated for yield and attributing characters under four environments(two locations x two seasons .The genotypes were; Sakha 93, Sakha 94, Giza 168, Sids 1, Sids 3, Sids 5, Gemmeiza 3, Gemmeiza 5, Gemmeiza 7 and Gemmeiza 9. The mean performance, phenotypic stability and interrelationship between various characters were computed as well as path coefficient. The results indicated that, significant genotypes; genotype x environment, environmental linear and genotype x environment linear variance for all studied characters. Regression coefficient (b) deviated significantly from unity (b > 1) for genotypes, Sids 1, Sids 3, Sids 5 for all characters aproximately; indicating that the genotypes were adapted to favorable environments.

The “b” value deviated significantly from unity and was less than one (b < 1) in Gemmeiza 7 for flag leaf area, number of spikes / plant, Sakha 93 for flag leaf area, plant height number of spikes/plant, number of spikelets/spike and 1000-grain weight and Giza 168 for number of spikelets / spike, 1000-grain weight and grain yield / plant, genotypes for considering the stability parameters (C.V% and S^2d accompanished with mean performance (X), the most desired and stable wheat genotypes were Gemmeiza 9 for all studied characters except number of spikes/plant . While Sakha 94 was stable for number of spikes/plant and grain yield / plant.

Correlation coefficients values were positive and significant between yield and its component for all studied characters except plant height. Path coefficient analysis indicated that number of spikes/plant and 1000-grain weight were the most prominent direct effects on grain yield / plant while number of spikes/plant, number of grains/spike and 1000 grain weight proved to have the highest indirect contribution to grain yield /plant.

INTRODUCTION

Plant breeders faced the problem of genotypes x environment interaction in the development of bread wheat cultivars. The interactions G x E interactions complicates selection of genotypes with superior performance. It has been suggested that a significant G x E interaction reduced the correlation between phenotypic and genotypic values as well as progress from selection (Kang and Martin, 1987). The effect of G x E on the relative performance and stability of genotypes. Across environment it is of great attention that it forms a challenge difficulty to the breeder when improving and developing superior genotypes (Eberhart and Russel, 1966). The effect of environmental stress on plant metabiolsm completelly and thereby reduction both growth and development of crop is still not completely understood (Pessarakli, 1994). Many researches on wheat studied the inheritance and

environmental effects Misra *et al*. 1991; Deswal *et al*. 1996; Kara 1997 Salem *et al*. 1998; Haji and Hunt 1999; Kara 2000, and El-Morshidy *et al*. 2001 .The present study was designed to estimate stability of grain yield and its related characters for ten released bread wheat cultivars.

MATERIALS AND METHODS

Four field experiments, including ten genotypes of wheat (*Triticum aestivum* L.) were undertaken at the two locations; Tag El- Ezz Research station, (Dakahilia Governorate) and Kafr Al-Hamam (Sharkia governorate). Experiments Station Agricultural Research Center (A.R.C). Egypt during the two successive winter growing seasons (2005/2006 and 2006/2007) for each trail. The planting date was during the third week of November in both seasons. Chemical analysis and physical properties of the experimental soil are presented in Table (1). The ten wheat genotypes were; Sakha 93, Sakha 94, Giza 168, Sids 1, Sids 3, Sids 5, Gemmeiza 3, Gemmeiza 5, Gemmeiza 7 and Gemmeiza 9. The randomized complete block design with three replications was used for each trial. The experimental plot consisted of 5 rows, row length was 2 m, row to row spacing was 20 cm., plant spacing was 10 cm. Data of the following characters (yield and its components) were estimated.

1- Flag leaf area $(cm)^2$: was calculated using the following formulae: maximum flag leaf length x maximum width x 0.72 (Lal and Subba Rao 1951) .
2- Plant height (cm)
3- Number of spikes/plant
4- Spike length(cm)
5- Number of spikelets/spike
6- Number of grains/spike
7- 1000-grain weight (g.)
8- Grainyield / plant (g.)

Biometric analysis:

Analysis of variance was performed for different characters through the two growing seasons according to Steel and Torrie (1980). Differenced among various cultivars were tested according to Duncan, (1955). Parameters were stability for studied characters of wheat genotypes under 4 environments (2 seasons x 2 location) according to Eberhart and Russel (1966) method.

2- Correlation studies:

Interrelation ships between different wheat characters were calculated according to the method described by Sndecor and Cochran (1980).

3- Path coefficient analysis, was applied according to Dewey and Lu (1959) and Duarte and Adams (1972), to partition the total correlation coefficients between yield and its primary components into direct and indirect effect.

Table (1): Some chemical and physical properties of the experimental soil at Tag El-Ezz Station.

Seasons	E.C.	T.S.S	pH	ESP%	OM%	Avaliable nutrients			Soil
						N	P	K	type
1st seasons	4.6	0.226	7.9	6.65	1.7	33	12	340	Saline
2nd seasons	4.1	0.219	7.9	5.60	1.9	38	12	370	Saline

Particle size distribution experimental							
Soil depth Cm	Coarse sand%	Fine sand%	Silt %	Clay %	OM%	$CaCO_3$%	Texture
0.30	0.30	20.50	26.30	47.00	2.10	2.60	Clay

Table (1b):.

Physical and Chemical analysis of the soil at Kafr Al-Hamam Exp. Sta.

Season	Physical analysi					Chemical analysi				Avaliable		
	Coarse sand%	Fine sand%	Silt %	Clay %	Texture class	$CaCo_3$	Organic matter	ECD	pH	N	P	K
2005/2006	2.65	23.04	30.50	46.46	Clayed	2.58	1.89	1.25	7.8	19.5	8.6	32
2006/2007	1.89	19.02	31.00	48.09	Clayed	2.74	1.98	1.32	8.1	20.9	8.0	289.6

RESULTS AND DISCUSSION

Analysis of variance due to stability parameters for eight studied characters for ten wheat genotypes under two locations i.e. Tag El-Ezz and Kafr-Al-Hamam Exp. Sta. are presented in Table (2). Statistical analysis exhibited that the mean squares among the wheat genotypes were highly significant for all studied characters suggesting that wheat genotypes were genetically different.

Genotypes (G) and environments (E) (two locations) had highly significant effect on all characters under study, indicating that these characters are affected by changes which happened in each location. Moreover the variances due to environments (Linear) was significant for all studied traits, indicating that these characters were highly influenced by the combination of environmental conditions (seasons and locations).

The interaction between genotypes and environments (Linear) had highly significant effect on the studied characters. These results are in agreement with those reported by Salem *et al* (1990) and Salem *et al* (2002).

The data obtained revealed significant variations for pooled devation regarding, plant height, number of spikes/plant, number of grains/spike, 1000-grain weight and grain yield/plant; exhibiting that stability of these characters are different

Coefficient of variabilaity (C.V.%) as standard measurement of stability (Tables 3 and 4) exhibited that the C.V. estimates diversed from either genotypes or character to another, these values ranged from 3.17 to 25.60% for flage leaf area, 3.81 to 25.93% for plant height, 2.90 to 25.73% for number of spikes/plant, 1.92 to 12.91% for spike length, 4.16 to 25.62% for number of spikelets/spike, 4.11 to 24.82% for number of grains/spike,

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3.01 to 24.52 for 1000 grain weight and 2.34 to 25.14 for grain yield/plant it could be noticed from the obtained data that the stable genotypes were Sakha 94 for flag leaf area, and number of spikes/plant, Sakha 93 for plant height and spike length and Gemmeiza 9 for number of spikes/plant, number of grains/spike, 1000-grain weight and grain yield/plant as they exhibited low value of C.V. on the other hand the wheat genotypes Sids 3, Sids 5 and Gemmeiza 5 for flag leaf area, spike length, number of spikelets / spike and number of grains/spike, Sids 1, Sids 3 and Sids 5 for plant height, number of spikes/plant, 1000-grain weight and grain yield/plant, that recorded the highest coefficient of variation Regression coefficient "b" (Table 3 and 4) deviated from unity (b > 1) in genotypes, Sids 3 and Sids 5 for all studied characters, Gemmeiza 3 for spike length and number of grains/spike, Gemmeiza 5 for number of grains/spike and grain yield/plant, indicating that the genotypes were adapted to favorable environments.

Otherwise, the "b" value deviated from unity and was less than one (b < 1) in genotypes Sakha 93 for flag leaf area, plant height, number of spikes /plant, number of spikelets/spike and 1000-grain weight, Gemmeiza 3 for plant height, Gemmeiza 5 for number of spikes /plant and spike length, Gemmeiza 7 for flag leaf area ,plant height and number of spikes / plant, and spike length, Giza 168 for number of spikelets/spike, 1000-grain weight and grain yield/plant indicating that these genotypes were more adapted to stress environments.

Considering the stability parameters (C.V. %), b and, S^2d) accompanished and mean performance (X), the most desired and stable wheat genotypes were; Gemmeiza 9 for flag leaf area, spike length, number of spikelets / spike, number of grains/spike, 1000-grain weight and grain yield / plant, Sakha 94 for number of spikes/plant, number of spikelets/spike, number of grains/spike and grain yield / plant.

Genotype Gemmeiza 9 recorded the highest for flag leaf area, plant height, spike length, number of spikelets/spike, number of grains/spike ,1000-grain weight and grain yield plant. Meanwhile Sakha 94 recorded the highest estimates for number of spikes/plant. In this respect; Awaad (1997), Haji and Hant (1999), Salem *et al* (2000), El-Morshidy *et al* (2001) Soheir Abd-Allah (2002) and Salem *et al*. (2002).

2- Simple correlation analysis:

Simple correlation coefficients, among studied characters are given in Table (5). Results showed that significant possitive correlation was found between grain yield/plant and all studied characters except plant height, between 1000-grain weight and each of flag leaf area ,spike length number of spikelets number of grains/spike and, each of between number of grains/spike and flag leaf area, spike length and number of spikelets /spike, between number of spikelets / spike and each of number of spikes/ plant , spike length, between spike length and each of flag leaf area and number of spikes/ plant.

Positive and significant correlation between characters, indicated that selection of these characters may improve wheat genotypes concerning high yielding ability. These results are in agreement with those obtained by Hamada (1988), Fayed (1992) and El-Bana and Aly (1993).

Table (5): Simple correlation coefficient (r) among studied characters of ten wheat genotypes (combined data over two seasons).

Characters	Flag Leaf area $(cm)^2$	Plant height (cm)	Number of spikes/ plant	Spike length	Number of spikelets/ spike	Number of grains/ spike	1000-grain weight (g.)	Grain yield/ plant (g.)
1-Flage leaf area (cm^2)		0.252	0.117	0.716**	0.361	0.615**	0.716**	0.892**
2- Plant height (cm)		-	-0.310	0.801	0.121	0.212	-0.192	0.301
3-Number of spikes/ plant			-	0.731**	-0.601*	-0.419	0.341	0.867**
4- Spike length				-	0.862**	0.868**	-0.516*	0.782**
5- Number of spikelets / spike					-	0.915**	**-0.761****	0.543*
6-Number of grains/ spike						-	**-0.614****	0.897**
7-1000-grain weight (g)							**-**	0.813**
8-Grain yield/plant (g.)								-

*** Significant at 0.05 levels significance**
**** Significant at 0.01 levels significance**

3- Path coefficient analysis:

Direct, indirect effect and total contribution of yield components are presented in Table (6). The results can be summarized as follows; number of spikes / plant, 1000-grain weight were the most prominent direct effects on grain yield/plant followed by number of grains /spike. Similar results were obtained by Eissa and Awaad (1994) who reported that yield variation was obtained for 1000-grain weight, spike length, number of spikes/plant and number of grains/spike. Spike length and flag leaf area provid to have the highest indirect contribution to grain yield/plant. The total contribution of all characters to yield/plant was 79.9%.

Table (6): Direct and indirect effects due to yield factors of wheat over both seasons of 2005/2006 and 2006/2007.

Components	Direct effect	Indirect effect	Total contribution	Direct (%)
Flage leaf area $(cm)^2$	0.017	0.067	0.084	8.416
Number of spikes/plant	0.082	0.165	0.247	40.594
Spike length	0.009	0.079	0.088	4.455
Number of grains/spike	0.033	0.121	0.154	16.336
1000-grain weight (g.)	0.061	0.165	0.226	30.70
R^2 %			0.799	

*** Significant at 0.05 levels significance**
**** Significant at 0.01 levels significance**

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تقدير إحصائيات الثبات ومعامل المرور لبعض التراكيب الوراثية فى القمح تحت ظروف بيئة مختلفة

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أقيمت أربعة تجارب حقلية فى موقعين مختلفين وهما محطة البحوث الزراعية بتاج العز – دقهلية ومحطة البحوث الزراعية بكفر الحمام – شرقية خلال الموسمين ٦/٢٠٠٥، ٧/٢٠٠٦ وذلك لدراسةبعض معالم الثبات لعشرة تراكيب من قمح الخبز المصرى للمحصول ومكوناته وتم إستخدام الأصناف سخا ٩٣، سخا ٩٤، جيزة ١٦٨، وسدس ١، سدس ٣، سدس ٥ وجميزة ٣، جميزه ٥، جميزة ٧، جميزة ٩، وكان التصميم المستخدم هو القطاعات الكاملة العشوائية فى ثلاث مكررات.

وقد أوضحت النتائج الآتى:

1- إختلاف التراكيب الوراثية تحت الدراسة فى إستجابتها لظروف الموقع والموسم الزراعى، وأظهرت نتائج الثبات أن الأصناف سدس ١، سدس ٣، سدس ٥، كانت المتأقلمة لظروف خاصة وعالية للصفات المختلفة، حيث كانت قيمة b لهذه الأصناف أكبر من الوحدة بينما كانت b أقل من الوحدة للصنف جميزة ٧، وذلك لصفة مساحة ورقة العلم، وعدد السنابل للنبات والصنف سخا ٩٣، وذلك لمساحة ورقة العلم وإرتفاع النبات وعدد السنابل للنبات وعدد السنيبلات / سنبلة ووزن الألف حبة والصنف جيزة ١٦٨ لصفات عدد السنيبلات / سنبلة ومحصول الحبوب للنبات وهذه الأصناف يمكن أن تتحمل الظروف البيئية القاسية.

بينما كان الصنف جميزة ٩ هو أكثر الأصناف ثباتا فى جميع الصفات ما عدا صفة عدد السنابل للنبات، كان الصنف سخا ٩٤ أفضل الأصناف ثباتا بالنسبة لعدد السنابل للنبات ومحصول الحبوب للنبات.

2- وجد إرتباط موجب ومعنوى بين محصول الحبوب للنبات وجميع الصفات ما عدا صفة إرتفاع النبات.

3- أوضح تحليل معامل المرور أن صفتى عدد السنابل للنبات ووزن الألف حبة كان لها أكبر مساهمة فى التأثير المباشر فى محصول الحبوب للنبات، بينما كان عدد السنابل للنبات وعدد حبوب السنبلة ووزن الـ ١٠٠٠ حبة لها تأثير غير مباشر على محصول الحبوب للنبات.

Table (2): Variance to stability analysis for flag leaf area, plant height, number of spikes/plant, spike length, number of spikelets/spike, number of grains/spike 1000-grain weight and grain yield/plant in wheat genotypes under two locations during 2005/2006 and 2006/2007 winter growing seasons.

S.O.V.	d.f.	Flage leaf area	Plant height	Number of spike/ plant	Spike length	Number of spikelets/ spike	Number of grains /spike	1000-grain weight	Grain yield/plant
Genotypes (G)	9	21.312**	38.91**	10.29**	15.76**	24.11**	55.07**	66.17	15.16**
Environments	3	47.91**	56.27**	20.89**	33.84**	26.45**	107.83**	123.04**	22.44**
G x E	27	11.28**	22.01**	9.75**	12.62**	30.12**	41.54*	38.42**	11.33**
Environment at (Env.x G	30	24.52**	39.75**	20.32**	5.48**	18.15**	65.26**	75.77**	25.66**
Environmenal linear	1	61.78**	111.92**	30.18**	12.79**	10.92**	23.75**	23.89**	13.75**
G x Env. (linear)	9	8.58**	13.23**	5.43**	4.13**	5.30**	19.48**	20.77**	10.11**
Pooled deviation	20	6.50	14.55**	4.62*	2.89	2.19	8.91**	10.29**	8.26**
Genotypes									
Sakha 93	2	7.82**	11.06**	4.11**	6.79**	4.13**	13.65**	11.55**	9.91**
Giza 168	2	8.53**	13.82**	5.89**	6.23**	3.62**	17.51**	17.00**	6.29**
Sids 1	2	5.36**	12.11**	3.16**	4.15**	4.88**	15.38**	16.11**	7.13**
Sids 3	2	7.82**	16.33**	7.80**	1.52	6.93**	2.26	1.88	6.20**
Sids 5	2	4.11**	8.17**	4.11**	5.36**	0.85	5.29*	3.92	5.11**
Gemmeiza 3	2	3.89*	2.52	1.52	2.11**	1.66	1.84	1.57	3.82*
Gemmiza 5	2	7.65**	3.85	2.07	1.19	2.13*	5.82	7.29**	1.65
Gemmeiza 7	2	1.16	1.24	1.85	0.06	0.82	1.93	2.38	4.11**
Gemmiza 9	2	1.14	5.16	3.41**	1.57	2.59**	9.98**	8.54**	3.02
Pooled error	120	1.88	1.79	1.19	0.97	0.93	2.55	2.92	1.600

Table (3): Estimates of stability parameters for flag leaf area, plant height, number of spikes/plant and spike length of ten wheat genotypes under two locations during 2005/2006 and 2006/2007 winter growing seasons.

Characters / Stability parameters	Flag leaf area (cm)^2				Plant height (cm)				Number of spikes/plant				Spike length (cm)			
	$\overline{X}$	C.V.%	bi	$\overline{S}$ d	$\overline{X}$	C.V.%	bi	$\overline{S}$ d	$\overline{X}$	C.V.%	bi	$\overline{S}$ d	$\overline{X}$	C.V.%	bi	$\overline{S}$ d
Genotypes																
Sakha 93	38.25	6.17	0.76	0.05	88.29	3.81	0.87	1.02	5.61	4.67	0.77	0.003	9.28	1.92	1.05	0.14
Sakha 94	39.24	4.14	1.11	0.14	95.55	4.88	1.09	2.16	8.22	2.90	0.94	0.004	11.94	3.06	1.09	0.28
Giza 168	29.67	3.17	1.08	0.32	90.28	4.91	0.99	2.87	6.23	4.75	0.98	0.010	10.21	2.96	1.01	0.33
Sids 1	36.64	16.17	1.26	1.03	97.11	25.62	1.53	8.14	5.14	22.26	1.41	0.075	11.53	7.00	1.82	
Sids 3	38.52	24.85	1.38	1.22	91.28	25.93	1.24	2.11	3.21	21.01	1.27	0.091	11.80	8.07	1.56	0.75
Sids 5	35.51	25.60	1.44	1.36	93.37	17.16	1.52	1.58	3.11	25.73	1.18	0.102	11.92	12.91	1.37	0.70
Gemmeiza 3	39.17	8.75	1.10	0.57	95.53	8.29	0.88	0.78	4.25	7.97	1.06	0.111	12.0	4.36	1.24	1.02
Gemmeiza 5	38.52	21.62	0.90	0.38	96.22	9.36	0.97	1.65	4.17	5.53	0.79	0.068	12.40	9.88	0.88	1.00
Gemmeiza 7	39.99	8.53	0.74	0.23	95.41	5.11	0.98	2.23	5.02	3.62	0.87	0.957	12.05	3.75	0.97	0.39
Gemmeiza 9	40.20	5.19	0.98	0.16	98.10	7.22	1.03	0.78	4.80	2.99	1.11	0.042	13.2	1.01	0.96	0.27
Overall mean	37.58				94.00					4.98			11.63			

Table (4): Estimates of stability parameters for number of spikes, number of grains/spike, 1000-grain weight and grain yield /plant in ten wheat genotypes under two locations during 2005/2006 and 2006/2007 winter growing seasons.

Characters / Stability parameters	Number of spikes/spike				Number of grains/spike				1000-grain weight (g.)				Grain yield/plant (g.)			
	$\overline{X}$	C.V.%	bi	$\overline{S}$ d	$\overline{X}$	C.V.%	bi	$\overline{S}$ d	$\overline{X}$	C.V.%	bi	$\overline{Sd}$	$\overline{X}$	C.V.%	bi	$\overline{S}$ d
Genotypes																
Sakha 93	19.61	11.28	0.87	0.19	59.11	5.11	1.19	0.73	56.66	7.62	0.80	0.56	21.18	4.11	1.11	0.52
Sakha 94	25.21	8.63	0.96	0.80	74.32	6.01	1.08	0.82	50.17	12.98	1.13	0.00	23.16	4.15	0.90	0.32
Giza 168	21.11	12.11	0.85	0.54	62.14	8.62	1.13	0.97	49.12	12.50	0.83	1.07	20.27	9.01	0.76	1.22
Sids 1	22.56	13.95	1.24	1.67	70.15	14.82	1.41	2.37	52.82	23.51	1.26	1.28	17.19	25.11	1.28	1.36
Sids 3	24.00	24.11	1.26	1.68	68.15	15.19	2.10	2.38	53.13	24.02	1.57	1.93	16.76	24.89	1.37	1.60
Sids 5	24.32	25.62	1.57	1.92	66.11	24.82	1.87	1.99	50.11	24.52	1.88	1.61	16.03	25.14	1.50	1.32
Gemmeiza 3	24.63	23.33	1.20	0.43	72.32	9.06	1.93	1.02	54.15	13.58	1.20	0.78	18.96	4.11	1.19	0.98
Gemmeiza 5	25.24	7.10	1.06	0.19	76.15	12.03	1.32	1.70	53.32	3.61	1.17	0.98	19.07	7.63	1.26	1.45
Gemmeiza 7	24.13	12.05	1.10	0.84	75.16	7.62	1.24	1.29	56.22	4.06	1.13	0.82	20.35	2.62	1.05	1.22
Gemmeiza 9	26.11	4.16	1.01	0.62	78.15	4.11	1.10	0.57	60.20	3.01	1.07	0.66	24.18	2.34	0.97	0.58
Overall mean	23.69				70.18					52.59			19.71			