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PHENOTYPIC AND GENOTYPIC STABILITY PARAMETERS FOR GRAIN YIELD AND ITS CONTRIBUTING CHARACTERS IN BREAD WHEAT (*Triticum aestivum* L.)

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ABSTRACT: Fifteen local and imported bread wheat genotypes were evaluated for grain yield/ fed., its components, days to 50% heading and flag leaf area under eighteen diverse environments, which ,. Phenotypic and genotypic stability parameters were estimated. The obtained results could be summarized as follows:

Pooled analyses of variance indicated, highly significant differences among wheat genotypes, seasons, locations and sowing dates as well as their first, second and third-order interactions for the studied yield contributing characters in most cases, providing evidence for the necessity of testing studied genotypes in multiple environments.

Stability analysis of variance revealed, highly significant GxE -"linear" for all the studied characters. The GxE-"linear" interaction also was significant when tested against the pooled deviation for grain yield/ fed., number of spikes/ plant, days to 50% heading and flag leaf area.

Phenotypic stability parameters indicated that wheat cultivars, Gemmeiza 5 and Gemmeiza 9 were classified as highly adapted to favorable environments for grain yield/ fed., number of grains/ spike and flag leaf area as well as ACSAD 941 for grain yield/ fed. and flag leaf area. Whereas, Sakha 8, Tsi-Vee 'S' and ACSAD 949 could be grown under Khattara or East Bitter Lakes (Sinai) as less favorable environment for grain yield/ fed. and flag leaf area. The most desired and stable genotypes were, Gemmeiza 7, ACSAD 903 and Sakha 69 for grain yield/ fed.; Gemmeiza 7 and Sakha 69 for both grain yield /fed. and 1000- grain weight as well as Sids 6 and Gemmeiza 7 for number of grains/ spike, days to 50% heading and flag leaf area.

Genotypic stability estimates revealed that, the most average stable genotypes were, Sakha 69 and ACSAD 903 for grain yield/ fed.; Tsi-Vee 'S' and ACSAD 935 for number of spikes/ plant, number of grains/ spike and flag leaf area; ACSAD 925 and ACSAD 939 for 1000-grain weight as well as Sahel 1 for days to 50% heading. However, Gemmeiza 7 had above average degree of stability for flag leaf area.

It is worthy to mention that, the two types of stability are quite similar for describing stability in wheat genotypes Sakha 69 and ACSAD 903 for grain yield /fed. and ACSAD 939 for 1000-grain weight. It is therefore suggested that these genotypes may be recommended to be included in any breeding program for improving wheat grain yield stability.

INTRODUCTION

Genotype x environment (GxE)-interactions are of notable importance in the development and evaluation of wheat cultivars. Although, it represents a major challenge to plant breeders, significant advances have been made to understand the nature of these interactions and determine the most stable genotype with a minimum (GxE). Phenotypic and genotypic stability parameters have been proposed by Eberhart and Russell (1966) and Tai (1971), respectively to provide information on the real response of phenotype and genotype to environments.

The "phenotypic stability" is often used to refer to fluctuations in the phenotypic expression of yield while the genetic composition of the varieties or populations remains stable (Becker and Leon, 1988). However, Hanson (1970) proposed stability statistic which is founded on the regression approach, this measure was termed as "genotypic stability", because it includes that part of the variance due to environmental effects which could be reduced by breeding or selection (Utz, 1972).

Many investigators have assessed the phenotypic stability of yield performance in wheat genotypes (Sharma *et al.*, 1984; Keser *et al.*, 1996; Awaad, 1997; Salem *et al.*, 2000; El-Morshidy *et al.*, 2001 and El-Marakby *et al.*, 2002). Also, genotypic stability of wheat grain yield and its related characters have been assessed by Moneim Babu Fatih (1987), Guilan Yue *et al.* (1990) and Salem et al. (1990), they reported significant differences among genotypes, environments and their interactions for grain yield and its attributes. Therefore, studying the performance and stability of various bread wheat genotypes over old and newly reclaimed environments may provide reliable information for recommendation of some cultivars to be grown under specific environments or to assist wheat breeders for planning breeding programs.

MATERIALS AND METHODS

Fifteen diverse bread wheat genotypes (Table 1) were evaluated for days to 50% heading, flag leaf area, number of spikes/plant, number of grains/spike, 1000-grain weight and grain yield (ard/fed.) under eighteen environments, which were the combinations between three locations; i.e., Experimental Farm of Faculty of Agriculture, Zagazig University, representing clay soil, Khattara Farm, representing sandy soil and East Bitter Lakes Farm (Sinai) of Faculty of Agriculture, Suez Canal University, representing sandy loam soil (Table 2), on three different dates; viz., November 4th and 25th and December 15th during two successive seasons of 1999/2000 and 2000/2001, using a randomized complete block design with three replicates. The experimental plot consisted of 6 rows, 3m long and 20 cm. apart. Wheat grains were handily drilled at a rate of 300 grains/m^2 for each genotype. The recommended cultural practices for wheat production were applied in each location. Regular analysis of variance was computed for each environment. Combined analyses of variance over environments were again conducted as outlined by Allard (1960). Phenotypic and genotypic stability analyses were computed according to Eberhart and Russell (1966) and Tai (1971), respectively.

Table (1): Name, origin and pedigree of the studied fifteen bread wheat genotypes.

No.	Name	Origin	Pedigree
1	Sakha 8	Egypt	Indus 66/ Norteno "S"- Pk3418-6e-1SW-OS
2	Sakha 69	Egypt	Inia/ RL 4220// 7c/ Yr "S" CM 15430-25-65-0s-0s
3	Giza 168	Egypt	MIL/BUC//Seri CM93046-8M-OY-OM-2Y-OB
4	Gemmeiza 5	Egypt	Vee "S"/SWM6525 CGM4017-1GM-6GM-3GM-OGM.
5	Gemmeiza 7	Egypt	CMH74 A.630/5 x //Seri:82/3Agent CGM4611-2GM-3GM-1GM-0GM
6	Gemmeiza 9	Egypt	Ald "S" / Huac "S"// CMH74A.630/5x CGM4583-5GM-1GM-OGM
7	Sahel 1	Egypt	N.S.732/Pim//Veery "S" Sd735-4sd-1 sd-Osd.
8	Sids 6	Egypt	Maya "S"/ Mon "S"//CMH74 A.592/3/Sakha8*2SD10002-4sd-3sd-1sd-Osd
9	Tsi/ Vee 'S'	Mex/Syr	CM 64335-3AP-1Ap- OAP
10	ACSAD 903	Syria	ACSAD529/4/C182.24/C168.3/3/Cno*2/7c//Cc/Tob Acs-W-8024-20 1Z-31Z-41Z-01Z
11	ACSAD 925	Syria	GEN/3/GOV/AZ//MUS "s"/4/Sannine/Ald's ACS-W-9174-101Z-51Z-31Z- 01Z
12	ACSAD 935	Syria	ACSAD 529// Yr/Sprw "s" ACS-W-8023- 11Z-21Z- 21Z-01Z
13	ACSAD 939	Syria	Maya "S"/ON//1160.147/3/BB/GLL/4/CHAT "s"/S/Vee "s"/Nac ACS-W-8163-21Z-31Z-51Z- 01Z
14	ACSAD 941	Syria	GEN/3/Gov/AZ//MUS"S"/4/Sannine/Aids "s" ACS-W-8174-10 1Z-21Z-51Z-01Z
15	ACSAD 949	Syria	Snb "s"/ ACSAD 305 ACS-W-8083-31Z-51Z-31Z-01Z

Table (2).: Particle size distribution of the surface samples*.

Location	Particle size distribution %			Texture class
	Sand	Silt	Clay	
Zagazig	13.3	32.1	54.6	Clay
Khattara	95.40	2.46	2.14	Sandy
Sinai	74.0	9.0	17.0	Sandy loam

*Samples of the soil were obtained from 25 cm. soil surface.

RESULTS AND DISCUSSION

Components of genotype x environment interaction:

Pooled analyses of variance for fifteen bread wheat genotypes (Table 3) provide evidence for highly significant environmental effects on the studied characters.

Table (3): Pooled analyses of variance for grain yield and its contributing characters of fifteen wheat genotypes under three sowing dates during two seasons in three locations.

S.O.V.	d.f.	Grain yield (ard□./fed■.)	No. of spikes/plant	No. of grains/ spike	1000-grain weight (g.)	Days to 50% heading	Flag leaf area (cm^2)
Seasons (S)	1	400.900**	0.699	11553.956**	5431.799**	954.529**	8122.126**
Locations (L)	2	1542.325**	35.936**	32177.558**	2266.103**	6726.265**	39634.430**
Seasons x Locations (SxL)	2	221.067**	34.462**	7909.019**	2111.490**	2789.609**	2453.070**
Reps in (SxL) combined	12	1.396	0.244	3.942	3.994	5.556	21.209
(D)	2	658.695**	51.172**	3768.947**	4072.080**	7364.429**	4721.335**
SxD	2	4.205**	9.226**	866.723**	235.724**	753.169**	36.494
LxD	4	26.789**	8.146**	330.372**	141.709**	1521.965**	155.281**
S x L x D	4	15.089**	10.424**	25.642*	181.912**	624.809**	72.845**
Genotypes (G)	14	42.293**	3.860**	225.058**	205.746**	473.248**	432.137**
G x S	14	6.807**	1.052**	54.486**	59.453**	65.899**	112.397**
G x L	28	27.019**	1.438**	237.861**	101.957**	136.893**	250.832**
G x D	28	14.126**	1.009**	67.580**	55.018**	91.449**	75.570**
G x S x L	28	3.098**	0.912**	55.819**	38.417**	26.183**	93.505**
G x S x D	28	6.111**	0.425**	90.263**	22.900**	26.499**	58.045**
G x L x D	56	13.958**	0.606**	85.363**	69.222**	38.037**	66.162**
G x S x L x D	56	6.348**	0.478**	54.877**	34.609**	21.328**	30.906**
Error	528	0.688	0.210	10.881	5.018	3.021	12.343

*,** denote significant at 5% and 1% levels of probability, respectively.

□ Wheat ardab=150 Kg

■ One feddan =4200m^2

Partitioning the environmental effects into seasons (S), locations (L) and sowing dates (D), and their interaction items, revealed that they were highly significant for wheat grain yield and its attributes in all cases, except(S)for number of spikes/plant, (SxD) for flag leaf area and (SxLxD) for number of grains/spike, which were insignificant. This result suggests that these characters were not influenced by the combination of environmental components (S),(L) and (D). Significant differences were recorded for genotypes (G) and their first-order interaction of (GxS), (GxL) and (GxD). Also highly significant second (GxSxL), (GxSxD) and (GxLxD) as well as third (GxSxLxD) order interactions have been noticed for grain yield and its attributes, implying different response of genotypes over seasons, locations and sowing dates. The obtained results provide evidence for the necessity of evaluating the studied wheat genotypes under several different environments in order to identify the best genetic makeup to be grown under a particular environment. Similar results were reported by Awaad (1997), Kandil *et al*. (1998), Salem *et al*. (2000) and El-Morshidy *et al*. (2001).

Stability analysis:

Stability analysis of variance of wheat grain yield and its attributes (Table 4) indicated highly significant mean squares of wheat genotypes for all the studied characters, revealing that wheat genotypes were genetically different for genes controlling these characters. Highly significant environment + (GxE) component and environment "linear" mean squares were recorded for all characters, indicating that the studied characters were highly influenced by the combination of environmental components (seasons, locations and sowing dates). Significant (GxE)-"linear" interactions were shown for all yield contributing characters, indicating that wheat genotypes responded differently to various environments. Thus, each genotype has specific environment, performed well under it, and different from another one. The (GxE)-"linear" interaction was significant when tested against the pooled deviation for grain yield/fed., number of spikes/plant, days to 50% heading and flag leaf area. This result suggests that, the differences in linear responses among genotypes across environments had occurred, and the linear regression and the deviation from linearity were the main components for differences in stability for the foregoing characters. Rasmusson and Glas (1967) emphasized that (GxE)-interaction should be considered one of the most important strategies for any breeding program to improve and develop new varieties. Previous reports of Sharma *et al.* (1984), Salem *et al* (1990), Keser *et al.* (1996), Awaad (1997), Salem *et al.* (2000), El-Morshidy *et al.* (2001) and El-Marakby *et al.* (2002), detected significant (GxE)-interaction on wheat grain yield and its attributes.

Table (4): Mean squares of stability analysis for wheat grain yield and its contributing characters.

S.O.V.	d.f.	Grain yield (ard./fed.)	No. of spikes /plant	No. of grains/spike	1000-grain weight(g.)	Days to 50% heading	Flag leaf area(cm^2)
Genotypes	14	42.293**	3.860**	225.058**	205.746**	473.248**	432.137**
E+(GxE)	255	10.537**	0.677**	218.671**	48.045**	74.267**	165.488**
E "Linear"	1	1805.549**	112.186**	34160.176**	8209.369**	14920.057**	34914.891**
GxE-"Linear"	14	9.963**	0.493**	72.602*	9.136**	26.554**	64.421**
Pooled deviation	240	3.091**	0.223**	85.768*	16.309**	15.193**	26.594**
Pooled error	504	0.229	0.038	40.077	1.667	1.021	4.090

***,** denote significant at 5% and 1% levels of probability, respectively.**

Phenotypic and genotypic stability parameters :

The estimates of phenotypic and genotypic stability parameters have been computed as described by Eberhart and Russell (1966) and Tai (1971), respectively for testing fifteen bread wheat genotypes grown under eighteen environments for grain yield/fed., number of spikes/plant, number of grains/spike, 1000-grain weight, days to 50% heading and flag leaf area (Table 5)

For grain yield (ard./fed.), the regression "b" value ranged from 0.258 (Tsi-Vee 'S') to 1.414 (ACSAD 941), and deviated significantly from unity (b >1) in wheat genotypes Gemmeiza 5 , Gemmeiza 9 and ACSAD 941, hereby could be grown under favorable environments. Otherwise, the "b" value was significantly less than unity (b <1) in Sakha 8, Tsi-Vee 'S' and ACSAD 949, indicating the suitability of these genotypes to Khattara or Sinai region as less favorable environment. In this respect, Hayward and Lawrence (1970) stated that the response to environment, as measured by the regression parameter was found to be highly heritable and controlled by genes with additive effects.

Concerning, the deviation from linear regression "S^2d", it was very small and not significantly deviated from zero in Sakha 69, Gemmeiza 7, Gemmeiza 9 and ACSAD 903 wheat genotypes, which showed high degree of stability for grain yield (Table 5). In this regard, Guilan Yue *et al.* (1990) reported that the "S^2d" seemed to be very important for estimating the stability, whereas, the remaining eleven wheat genotypes were unstable.

A simultaneous consideration of the three stability parameters ($\bar{x}_i$, b_i and S^2d_i), it can be seen that, the most desired and stable genotypes were; Gemmeiza 7, ACSAD 903 and Sakha 69. Eberhart and Russell (1966) described the most stable genotype which has high mean performance over environments, with "b" value approached near unity and the deviation from regression as minimum as possible ($S^2d = 0$).

With regard to the genotypic stability, Tai (1971) partitioned (GxE)-interaction effect of a variety into two components; i.e., "α" statistic which measures the linear response to environmental effects and "λ" statistic which measures the deviation from the linear response. A perfect stable variety has $\alpha = -1$, $\lambda = 1$. However, the average stable genotype has $\alpha = 0$, $\lambda = 1$, whereas the above average stable genotype should have an estimate of $\alpha < 0$, $\lambda = 1$ and the values $\alpha > 0$ and $\lambda = 1$ described as below average stable one. It is evident that, the estimation of genotypic stability statistic "α" was not significantly different from $\alpha = 0.0$ for the studied wheat genotypes, except for Gemmeiza 9, Tsi-Vee 'S' and ACSAD 941. The statistic "λ" was significantly different from $\lambda = 1$ for all genotypes, except Sakha 69 and ACSAD 903. According to the interpretation of Tai, the relative unpredictable component of "λ" may be more important than the relative predictable component "α". As illustrated in Fig. (1), the average stability area contained Sakha 69 and ACSAD 903, and they exhibited high yield potentiality. The other wheat genotypes were considered unstable.

For yield components, the estimates of phenotypic stability parameters (Table 5) indicated that, the most adapted wheat genotypes for improved environments were, Sids 6 and Gemmeiza 7 for number of spikes/plant; Giza 168, Gemmeiza 5 and Gemmeiza 9 for number of grains/spike as well as Gemmeiza 5 for 1000-grain weight. However, Gemmeiza 9 and ACSAD 949 were suited to less favorable conditions for number of spikes/plant; ACSAD 935, ACSAD 939 and ACSAD 949 for number of grains/spike as well as Sids 6 and ACSAD 903 for 1000-grain weight. In the case of the insignificant "b" value, the deviation from regression "S^2d" is considered the most appropriate criterion for measuring phenotypic stability, because it measures the predictability of genotypic reaction to various environments (Becker *et al.*, 1982). It can be noticed that "S^2d" values were small and insignificant in Gemmeiza 7, Tsi-Vee 'S' and ACSAD 941 for number of spikes/plant; Gemmeiza 7, Sahel 1, Sids 6, ACSAD 903 and ACSAD 941 for number of grains/spike and Sakha 8, Sakha 69,Gemmeiza 7, Gemmeiza 9, Sahel 1, Sids 6, Tsi-Vee 'S', ACSAD 925, ACSAD 935 and ACSAD 939 for 1000-grain weight, which showed high degree of stability. However, the remaining genotypes were sensitive ones. Ideally, the most desired and stable genotypes for yield components were, ACSAD 941 for number of spikes/plant; Sids 6, Sahel 1 and Gemmeiza 7 for number of grains/spike and Gemmeiza 7, ACSAD 939, Sakha 69, Gemmeiza 9 and ACSAD 935 for 1000-grain weight. Therefore, they could be grown under wide range of environments.

According to Tai's method, the most average stable genotypes were Sakha 8, Gemmeiza 5, Tsi-Vee 'S', ACSAD 935 and ACSAD 941 for number of spikes/plant ; Sakha 69, Giza 168, Tsi-Vee 'S' and ACSAD 935 for number of grains/spike as well as ACSAD 925 and ACSAD 939 for 1000-grain weight. They exhibited "α" values not deviated significantly from zero with "λ" approached near unity. The other tested genotypes were unstable (Table 5 and Figs. 2,3 and 4).

For days to 50% heading, phenotypic stability estimates (Table 5) revealed that the "b" value ranged from 0.596 (Giza 168) to 1.212 (Sakha 8). Sakha 8 genotype showed good level of earliness under improved environments (b>1). However , Giza 168 was moderate in heading and responsiveness. Whereas, Gemmeiza 5, Gemmeiza 7, Gemmeiza 9, Sids 6 and Tsi-vee 'S' appeared to be more stable as revealed by lower and insignificant S^2d. The other wheat genotypes were sensitive ones.

Table (5): phenotypic and genotypic stability parameters for grain yield and its contributing characters of fifteen bread wheat genotypes under eighteen environments.

Character / Parameter / Genotype	Grain yield (ard./fed.)					No. of spikes/plant					No. of grains /spike				
	$\bar{x}_i$	b_i	S^2d_i	α	λ	$\bar{x}_i$	b_i	S^2d_i	α	λ	$\bar{x}_i$	b_i	S^2d_i	α	λ
1-Sakha 8	12.249	0.792*	2.359**	-0.014	19.168*	3.381	1.051	0.089*	0.013	2.096	43.562	1.174	81.202**	-0.012	3.988*
2-Sakha 69	13.596	0.951	1.224	-0.0136	2.48	2.962	1.106	0.211**	0.029	9.861*	40.479	0.995	35.563*	0.003	0.874
3-Giza 168	13.445	0.955	2.019*	-0.0123	10.035*	3.268	1.075	0.224**	0.021	10.323*	45.083	1.348*	43.676**	0.041	1.554
4-Gemmeiza 5	14.937	1.297*	3.339**	-0.0007	18.808*	2.884	0.785	0.096*	-0.059	1.927	44.278	1.429*	25.452*	0.038	3.144*
5-Gemmeiza 7	14.332	1.108	1.751	0.029	13.942*	3.347	1.367*	0.073	0.103*	12.726*	44.388	1.107	9.910	0.039	3.424*
6-Gemmeiza 9	14.104	1.379*	1.635	0.103*	18.062*	3.091	0.629*	0.143**	-0.102*	8.951*	44.304	1.417*	25.606*	0.040	3.575*
7-Sahel 1	13.458	0.914	4.359**	-0.023	26.273*	2.799	1.287	0.289**	0.078	13.911*	45.02	1.106	-8.893	0.056*	5.856*
8-Sids 6	12.503	1.147	3.814**	0.043	27.319*	2.393	1.551**	0.497**	0.149*	14.000*	54.222	1.194	15.893	0.055*	3.568*
9-Tsi/ Vee 'S'	11.637	0.258**	5.036**	-0.202*	8.502*	2.461	0.946	0.053	-0.014	1.581	42.89	0.992	46.547*	-0.007	1.753
10-ACSAD 903	13.648	0.944	0.581	-0.014	2.367	2.838	0.947	0.249**	-0.014	11.284*	42.824	0.968	-9.319	-0.012	5.568*
11-ACSAD 925	12.683	1.141	2.307*	0.037	18.085*	2.643	1.057	0.124**	0.015	6.553*	41.509	0.837	26.617*	-0.032	3.186*
12-ACSAD 935	13.026	1.089	3.167**	0.024	23.210*	2.766	0.873	0.090*	-0.0.35	2.296	43.385	0.697*	43.839**	-0.045	1.881
13-ACSAD 939	12.753	0.865	2.060*	-0.036	16.089*	2.639	0.857	0.110**	-0.039	6.102*	43.696	9.691*	26.278*	-0.080*	5.077*
14-ACSAD 941	14.279	1.414**	5.897**	0.111*	27.685*	3.008	0.997	0.038	-0.054	2.402	42.315	0.981	-6.981	-0.002	2.487*
15-ACSAD 949	10.486	0.741*	3.378**	-0.072	23.454*	2.838	0.661*	0.268**	-0.091	13.498*	39.081	0.760*	42.321**	-0.050*	2.556*
Grand mean	13.142					2.888					43.802				
L.S.D 0.05	1.155					0.310					3.086				
	1000-grain weight (g.)					Days to 50% heading					Flag leaf area (cm²)				
1-Sakha 8	41.843	0.961	12.701	-0.015	13.431*	83.018	1.212*	10.623**	0.059	20.567*	35.093	0.809*	11.389**	-0.015	6.083*
2-Sakha 69	44.329	1.076	11.164	0.022	13.407*	84.555	0.954	10.750**	-0.017	20.322*	36.377	0.877	12.449**	-0.021	6.212*
3-Giza 168	41.601	1.039	20.883**	0.009	21.306*	86.251	0.596**	26.411**	-0.109*	21.203*	39.392	0.979	40.618**	-0.024	15.519*
4-Gemmeiza 5	46.369	1.211*	29.422**	0.056*	21.800*	83.566	0.847	6.173	-0.039	11.662*	41.770	1.256*	21.938**	0.069*	14.336*
5-Gemmeiza 7	45.894	0.998	15.670	-0.002	21.900*	85.011	0.942	4.485	-0.020	8.655*	39.891	1.152	7.274	-0.161*	2.506
6-Gemmeiza 9	43.835	0.984	9.824	-0.003	10.058*	91.628	0.902	8.232	-0.022	15.921*	42.407	1.290**	8.621	0.051	18.587*
7-Sahel 1	41.285	1.029	8.377	0.005	9.431*	81.889	1.201	43.124**	0.052	2.365	38.422	0.915	22.128**	-0.033	7.640*
8-Sids 6	40.887	0.828*	9.853	-0.047*	11.682*	82.006	1.149	7.213	0.044	14.437*	39.037	1.072	7.465	-0.009	7.006*
9-Tsi/ Vee 'S'	39.906	1.012	13.414	0.003	13.800*	84.996	1.17	6.226	0.047	13.187*	35.946	0.802*	12.582**	0.003	2.151
10-ACSAD 903	41.175	0.686*	17.202*	-0.087*	19.763*	83.364	1.015	12.371**	0.00067	21.849*	34.946	1.038	26.162**	-0.034	11.223*
11-ACSAD 925	41.217	0.947	5.798	-0.014	2.154	85.969	1.047	15.237**	0.014	21.386*	38.222	1.001	48.732**	0.053	21.885*
12-ACSAD 935	43.170	1.133	7.846	0.036	8.019*	89.988	0.943	20.594**	-0.015	20.791*	33.699	0.816*	32.832**	-0.047	2.412
13-ACSAD 939	44.737	1.140	3.908	0.035	2.201	92.368	1.066	14.752**	0.012	19.920*	36.552	0.883	16.123**	0.009	12.794*
14-ACSAD 941	44.448	0.905	19.683*	-0.015	16.257*	90.883	0.866	16.481**	0.050	18.840*	34.483	1.223*	37.739**	-0.025	9.502*
15-ACSAD 949	43.213	1.043	23.850**	0.009	21.552*	88.202	1.086	9.840**	0.021	15.590*	34.022	0.805*	31.497**	-0.078*	9.234*
Grand mean	42.947					86.246					37.350				
L.S.D 0.05	2.456					2.561					3.389				

*,** Significant at 5% and 1% levels of probability, respectively. *α value significantly from α= 0 at the 0.05 probability level.

*λ value greater than Fa value derived from F-table with n_1= 14, n_2= 504 and a=0.05.

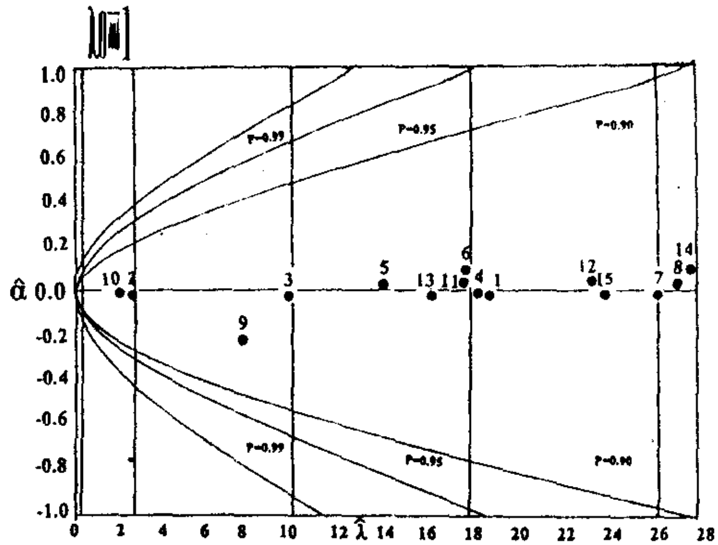

Fig. (1):Distribution of stability statistics for grain yield/fed. of fifteen wheat genotypes.

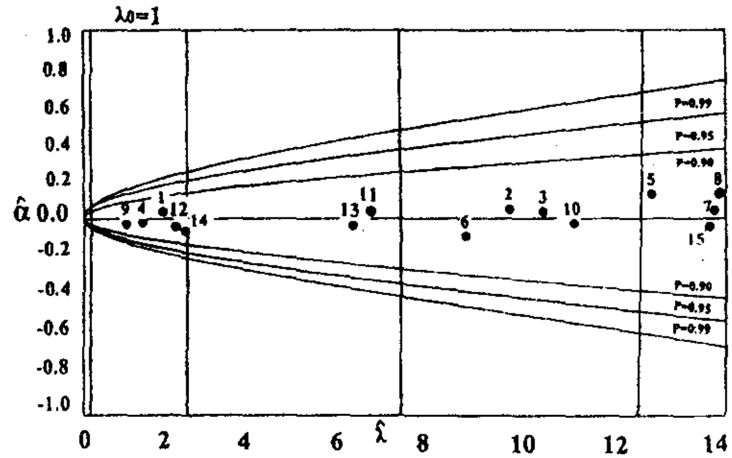

Fig. (2):Distribution of stability statistics for number of spikes/plant of fifteen wheat genotypes.

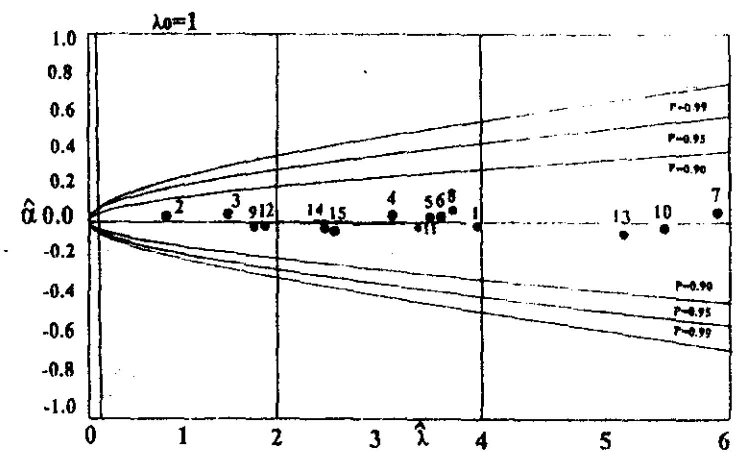

Fig (1):Distribution of stability statistics for number of grains /spike of fifteen wheat genotypes.

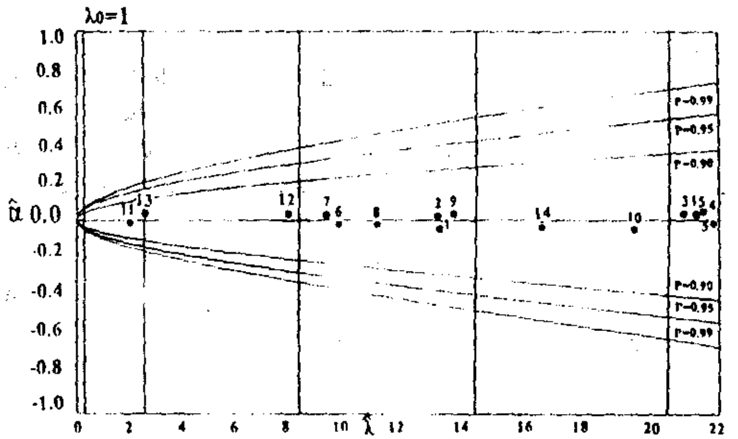

Fig. (4): Distribution of stability statistics for 1000-grain weight of fifteen wheat genotypes.

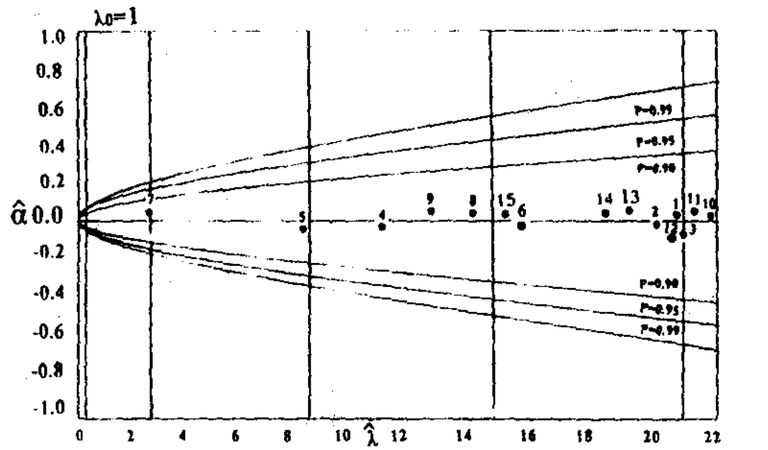

Fig. (5): Distribution of stability statistics for days to 50% heading of fifteen wheat genotypes.

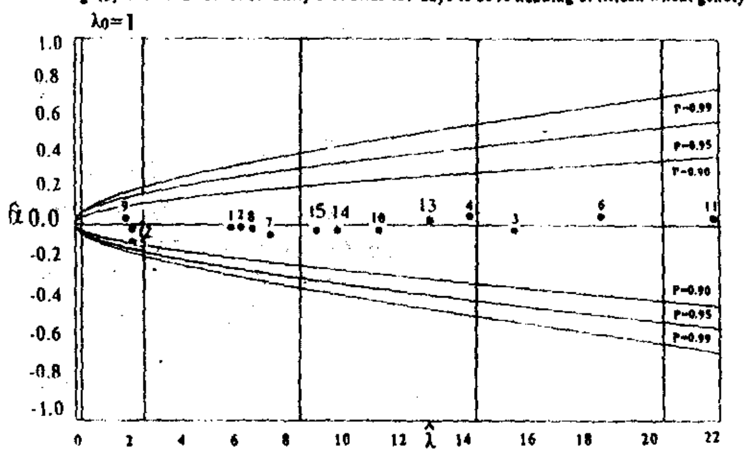

Fig. (6): Distribution of stability statistics for flag leaf area of fifteen wheat genotypes.

It is important to mention that, Sids 6, Gemmeiza 5 and Tsi-Vee 'S' met all criteria of ideal genotype, therefore they ranked as the most desired and stable ones.

The values of "α" and "λ" showed great differences among genotypes, and most genotypes had alpha "α" statistics were not deviated significantly from α =0, but exhibited "λ" values deviated significantly from unity for all genotypes, indicating unstable, except Sahel 1 which showed average degree of stability with good level of earliness (Table 5 and Fig.5).

Flag leaf area is an important character in their contribution of wheat grain yield (Awaad, 2001). The response to environments as measured by the regression parameter indicated that Gemmeiza 5, Gemmeiza 9 and ACSAD 941 were fitted to improved environments. Whereas, Sakha 8, Tsi-Vee 'S', ACSAD 935 and ACSAD 949 were adapted to stress conditions. It can be seen that, "S^2d" was small and insignificant in Gemmeiza 7, Gemmeiza 9 and Sids 6, these genotypes were considered more stable. Otherwise, the remaining wheat genotypes were sensitive ones. In the meantime, Gemmeiza 7 and Sids 6 were ranked as the most desired and stable genotypes as they had broader flag leaf area, "b" value approached near unity with lowest and insignificant "S^2d".

With regard to Tai's procedure, the "α" and "λ" values differed from genotype to another. Tsi-Vee 'S' and ACSAD 935 have been located in the area of average stability. However, Gemmeiza 7 had above average degree of stability (Fig.6) with broader flag leaf area (Table 5).

From the forementioned results, it is evident that the two types of stability are quite similar for describing stability in wheat genotypes Sakha 69 and ACSAD 903 for grain yield /fed. and ACSAD 939 for 1000-grain weight, but differed in evaluating stability of the remaining materials. This could be due to the genetic makeup of wheat germplasm and the high influence of environmental changes as well as (GxE)-interaction. Similar conclusion was reported by Duarte and Zimmermann (1995). It is therefore suggested that, Sakha 69, ACSAD 903 and ACSAD 939 may be recommended to be included in any breeding program for improving wheat grain yield stability.

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معالم الثبات المظهري والوراثي لمحصول الحبوب ومساهماته فى قمح الخبز
(*Triticum aestivum* L.)

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أجريت هذه الدراسة بهدف تقييم ثبات خمسة عشر صنفاً من قمح الخبز، ثماني منها محلية هي سخا ٨، سخا ٦٩، جيزة ١٦٨، جميزة ٥، جميزة ٧، جميزة ٩، ساحل ١، سدس ٦ ،وسبعة تراكيب وراثية أجنبية هي 'S' Tsi-Vee، أكساد ٩٠٣، أكساد ٩٢٥، أكساد ٩٣٥، أكساد ٩٣٩، أكساد ٩٤١ و أكساد ٩٤٩ وذلك لصفات محصول حبوب الفدان ومكوناته بالإضافة إلى عدد الأيام حتى طرد ٥٠% من السنابل ومساحة ورقة العلم، تحت ثماني عشر بيئة مختلفة (موسمان زراعيان x ثلاثة مواعيد زراعة x ثلاثة مواقع). وتم حساب قيم الثبات المظهرى بطريقة إيبرهارت

وراسيل(١٩٦٦)والوراثى بطريقة تاى(١٩٧١). ويمكن تلخيص أهم النتائج فيما يلي:

أظهــر التحليل التجميعى للبيانات ، وجود أختلافات عالية المعنوية بين التراكيب الوراثية والمواســم والمواقع ومواعيد الزراعة وكذلك تفاعلاتها للصفات المدروسة في معظم الحالات ، في دلالة على ضرورة تقييم التراكيب الوراثية المدروسة فى بيئات متعددة.

تشــير نــتائج تحلــيل الثبات إلى أن، التفاعل (الخطى) بين التركيب الوراثى x البيئة كان معــنويا للصفات المدروسة، موضحا تباين التراكيب الوراثية فى استجابتها للتغيرات البيئية، أي أن كل صنف يجود تحت ظروف بيئية معينة، ويختلف في ذلك عن الأصناف الأخرى. وكانت قيم التفاعل (الخطــى) بيــن التركيب الوراثى x البيئة معنوية عند اختبارها أمام قيم الانحرافات الكلية لصفات، محصــول حبوب الفدان، عدد سنابل النبات، عدد الأيام حتى طرد ٥٠% من السنابل ومساحة ورقة العلــم ، مشــيراً إلى أن الانحدار الخطى والانحرافات عن خط الانحدار يمكن أستخدامهما كمقاييس لوصف ثبات التراكيب الوراثية لهذه الصفات.

أظهــرت معــالم الثبات المظهرى ، تميز صنفا القمح المحليين جميزة ٥ وجميزة ٩بدرجة عالــية مــن الأقلمــة لظروف البيئات الملائمة لصفات محصول حبوب الفدان وعدد حبوب السنبلة ومساحة ورقة العلم، والصنف أكساد ٩٤١ لمحصول حبوب الفدان ومساحة ورقة العلم. بينما يمكن التوصــية بزراعة الأصناف سخا ٨، Tsi-Vee 'S' وأكساد ٩٤٩ تحت ظروف منطقة الخطارة أو مــنطقة شــرق البحيرات (سيناء) كبيئات أقل ملاءمة لصفتي محصول حبوب الفدان ومساحة ورقة العلم.

كمــا أشــارت النــتائج إلــي أن أكثر الأصناف قبولا وثباتا تحت مدى واسع من البيئات المتباينــة، جميزة ٧، أكساد ٩٠٣و سخا ٦٩ لمحصول حبوب الفدان ؛ جميزة ٧ وسخا ٦٩ لصفتي محصول حبوب الفدان ووزن الألف حبة و الصنفان سدس ٦ وجميزة ٧ لصفات عدد حبوب السنبلة، عدد الأيام حتى طرد ٥٠% من السنابل ومساحة ورقة العلم.

وأظهر تحليل الثبات الوراثى أن ، أكثر الأصناف ثباتا لمدي واسع من البيئات صنفي القمح ســخا ٦٩ وأكســاد ٩٠٣ لصفة محصول حبوب الفدان، والسلالتين Tsi-Vee 'S' و أكساد ٩٣٥ لصــفات عــدد سنابل النبات، عدد حبوب السنبلة ومساحة ورقة العلم؛ وأكساد ٩٢٥ وأكساد ٩٣٩ لصــفة وزن الألــف حــبة وساحل ١ لصفة عدد الأيام حتى طرد ٥٠% من السنابل. وتميز الصنف جميزة ٧ بدرجة ثبات عالية above average stability لمساحة ورقة العلم.

ولقد توافقت نتائج مؤشرات الثبات المظهري والوراثي في وصف ثبات صنفي القمح سخا ٦٩ وأكســاد ٩٠٣ لصفة محصول حبوب الفدان ، والتركيب الوراثي أكساد ٩٣٩ لصفة وزن الألف حــبة، مقــترحاً إمكانــية التوصية باستخدام هذه الأصناف في برامج التربية لتحسين ثبات محصول حبوب قمح الخبز.