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GENOTYPE BY ENVIRONMENT INTERACTION IN GRAIN SORGHUM GENOTYPES UNDER UPPER EGYPT CONDITIONS

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ABSTRACT

Evaluation of sorghum genotypes under different environments is essential for testing stability in performances and degree of adaptations of genotypes and considered an important goals of breeding programs. In this respect, 13 grain sorghum genotypes (*Sorghum bicolor* (*L.*) Moench) derived from diverse origins were evaluated for several traits during 2010/2011, 2011/2012 and 2012/2013 growing seasons at two locations, namely Shandaweel and Arab El-Awamer Agric. Res. Stations. Thus, the evaluation included six environments. The joint regression analysis showed highly significant differences among each of genotypes and environments as well as genotype x environment interactions .This results indicated differential responses due to changes in environment. The G × E interactions showed significant linear functions with the environments for all studied traits, except for panicle length. The stability parameter (b_i) for grain yield per plant was quite variable among the genotypes ICSR -89016 and ICSR-93002 which were insignificantly deviated from unity, indicating average stability. The parameters of ICSR-89016 and ICSR-93002 were insignificantly deviated from zero indicating greater stability over the range of environments for grain yield per plant.

Keywords: Sorghum, Regression stability analysis

INTRODUCTION

Exploitation of genetic variability is the most important tool in plant breeding especially in sorghum breeding and this has to be inferred by phenotypic expression. The consequences of the phenotypic variation largely depend on the environment. This variation is further complicated by the fact that all genotypes do not interact similarly with the changes in the environment. Mean yield across environments would be an adequate indicator of genotypic performance in the absence of genotype by environment (GE) interaction. Most often, GE complicates breeding, testing and selection of superior genotypes. There for, is important to identify those specific genotypes which are adapted or stable over a set of environments. thereby achieve quick genetic gain through screening of genotypes for greater adaptation and stability prior to release them as cultivars (Ariyo 1989, Flores *et al.*, 1998; Showemimo *et al* 2000, Mustapha *et al* 2001 and Yan and Kang 2003).

Changes in climate and atmospheric conditions are among the major factors that would greatly influence farm production and management in the future.Therefore,climatic changes which are expected to occur would play a major role in directing the plant breeders. Stability of yield and the ability of a genotype to avoid substantial fluctuations in yield over a range of environments is a breeding objective which would be difficult to achieve.

Mechanisms of yield stability fall into four general categories; genetic heterogeneity, yield component compensation, stress tolerance, and capacity to recover rapidly from stress (Heinirich *et al.* 1983). Adaptability and stability of performance of cultivars over locations and years are important for national policy in crop production. Therefore, a grain producer is primarily interested in growing a cultivar with high yield and stability of performance at a proper location. Yield stability across different environments is an important consideration in crop breeding programs that target areas with variable climatic patterns (Feizias *et al.*, 2010), So, most plant breeding programs in agricultural research center resorts to evaluate genotypes across different environments.

Analysis of stability of green sorghum genotypes was investigated over 14 different production environment at Middle and Upper Egypt. Eweis (1998) reported that genotype × environment interactions were always highly significant and suggested estimating yield stability in selection programs. Studying a number of crosses of grain sorghum in different environments, Ali (2000) found that mean squares due to crosses × environments (linear) interaction were highly significant for panicle weight and grain yield. Mean while, Mostafa (2001) reported that genotypes and genotypes × years interactions for all studied traits were significant, while those due to years and genotypes x years interaction for 1000- kernel weight, were non-significant. A joint regression analysis performed by Ali (2006) of variance showed significant variances due to genotypes, environments and the genotype × environment interaction for most of the studied traits of grain sorghum. Six genotypes were found to be more stable for number of days to flowering, five genotypes for plant height, two for grain yield/plant, and 7 genotypes for 1000 grain weight. Genotypes x environment interactions were found to be operating several traits studied by Mahmoud *et al.* (2007) with the being accounted for by the linear regression on the environmental means. Stability parameters across all environments indicated that, all genotypes exhibited significant linear response to environmental conditions. Mahdy *et al.* (2011) reported that, the interaction effects of genotypes with planting dates were highly significant for all studied traits, whereas genotype x year interaction effect was highly significant for days to blooming, plant height and grain yield. Genotype x year x planting date interaction effect was highly significant for plant height, 1000-grain weight and grain yield. However, genotype x year x location x planting date interaction effect was highly significant only for plant height and grain yield. Mahmoud *et al.* (2012) found highly significant differences among genotypes, environments and genotype × environment interaction for several traits in grain sorghum. For grain yield per plant, the genotypes varied in their response to changes in the environment as indicated by the (bi) values.

Therefore, The objective of the present investigation was to study the performances and stability parameters of yield and its components in some grain sorghum genotypes over six environments which were the combinations of three years × two locations .

MATERIALS AND METHODS

Thirteen grain sorghum genotypes (*Sorghum bicolor* (L.) Moench) from diverse origins which are presented in Table 1 were evaluated at Arab El-Awamer and Shandaweel Agric. Res. Stations over the three growing seasons of 2011, 2012 and 2013. The soil at all sites was analyzed in the results are presented in Table 2. The experimental layout was a randomized complete blocks design with three replications. Each genotype was sown in one row 4.0m in length and 50cm in width. Planting were done in hills spaced 15cm apart within rows. Later on, seedlings were thinned to two plants per hill. Data were recorded on days to 50 % flowering , Plant height (cm) , 1000 kernel weight (g), Panicle width (cm) ,Panicle length (cm) and Grain yield / plant (g). The joint regression analysis was performed for each trait according to the method of Eberhart and Russell (1966). Three criteria would be realized to consider a genotype is a stable one. These criteria are follows:

1-Regression coefficient is significantly different from zero ($b \neq 0$) but not significantly different from unity ($b = 1$).

2-Non- significant sums of squares of the deviation of regression, i.e., $S^2_d = 0$.

3- High performance with a reasonable range of environmental variation.

Table 1. Origin of the thirteen grain sorghum genotypes.

No.	genotype	Origin	No.	genotype	Origin
1	R line-629	India	8	ZSV-14	Zimbabwe
2	SV-1	India	9	ICSV- 273	India
3	Dorado	USA	10	ICSR-89039	India
4	NM-36565	Zimbabwe	11	MR-812	Zimbabwe
5	ICSR- 89028	India	12	ICSR-93001	India
6	R line-924	India	13	ICSR-93002	India
7	ICSR-89016	India			

Table 2 . Some physical and chemical properties of the experimental sites.

Properties	Arab El Awamer			Shandaweel		
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013
Mechanical analysis:						
Sand (%)	85.40	87.20	87.30	55.91	30.64	42.33
Silt (%)	8.70	7.20	8.00	11.84	24.26	19.88
Clay (%)	5.90	5.60	5.7	32.25	45.10	40.33
Texture	Sandy			Clay		
Chemical analysis:						
EC (1:1 extract) (dsm^{-1})	8.21	8.43	8.33	0.39	0.84	0.66
pH (1:1 suspension)	0.59	0.77	0.65	7.60	7.90	6.99
Available						
Total nitrogen (%)	0.06	0.04	0.06	1.26	0.80	1.02
$NaHCO_3$-extractable P (ppm)	5.14	4.88	5.00	8.33	6.30	9.70
NaOAC-extractable K (ppm)	0.14	0.12	0.12	0.33	0.26	0.35
Total $CaCO_3$ % (ppm)	27.33	32.15	32.0	2.33	2.86	1.72
Organic matter (%)	0.82	0.76	0.85	1.89	1.32	1.66

RESULTS AND DISCUSSION

1 -Analysis of variance

Data for each trait was statically analyzed as usual .Test of homogeneity of the error mean squares across all environments was done according the method of Eberhart and Russell (1966).When the error mean squares were homogenous, therefore the combined analysis would followed up as presented in Table3.

Table3. Means square of combined analysis of variance for the studied traits.

Source of variation	df	Mean squares					
		Plant height	Grain yield	Panicle length	1000 kW	Panicle width	Date flowering
Environments(E)	5	3978.8**	3991.9**	25.26**	844.1**	4.269**	1600.9**
Rep.(E)	12	17.62	6.281	3.377	3.329	0.065	1.688
Genotypes(G)	12	26929.7**	5560.3**	78.08**	1830.6**	3.855**	148.3**
E x G	60	170.8**	205.2**	7.698**	84.37**	0.736**	12.24**
Error	144	8.256	2.593	1.620	2.755	0.066	3.859

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

The combined analyses of variance in Table 3 revealed the presence of highly significant differences among genotypes, environments and genotypes x environments interaction for all studied traits. In other words, the rank of any given genotype varied within each environment from one year to another. The proportional participations of environments, genotypes and genotypes by environments interactions varied from trait to trait.

2- Mean Performance Of Genotypes

A- Days To 50% Flowering

The means of number of days to 50% flowering of the 13 grain sorghum genotypes at two locations in 2011, 2012 and 2013 seasons are presented in Table 4. The results showed different performance of genotypes from year to year and from location to another. The mean of days to 50 % flowering across all environments ranged from 69.88 days for ICSR-93002 to 78.38 days for ZSV-14. The average of days to 50% flowering across all genotypes and environments was 75.38 days.

Table 4:- Means of days to 50% flowering of the thirteen grain sorghum genotypes at two locations from 2011 to 2013 seasons.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	81.7	82.3	82.7	71.0	71.3	70.3	76.38
SV-1	84.7	86.0	82.3	70.7	70.0	69.3	77.16
NM- 36565	83.7	81.0	83.0	70.3	71.0	71.7	76.78
ICSR-89028	84.7	82.0	81.7	70.3	70.7	69.7	76.51
R line-924	87.0	84.3	82.7	73.3	71.3	70.7	78.21
ICSR-89016	87.3	82.3	86.3	70.3	69.7	68.3	77.36
ZSV-14	87.7	85.3	82.0	72.0	72.3	71.0	78.38
ICSV-273	86.0	82.3	84.7	70.0	70.3	68.7	77
ICSR-89039	84.3	83.3	82.3	70.0	67.7	70.3	76.31
MR-812	74.3	75.0	75.0	69.7	68.7	66.3	71.5
ICSR-93001	76.7	77.7	73.3	67.7	67.0	67.7	71.68
ICSR-93002	72.7	74	73.7	67.3	65.3	66.3	69.88
Dorado	78.0	78.0	75.0	68.3	69.3	67.3	72.65
Average	82.21	81.038	80.36	70.06	69.58	69.04	75.38

B- Plant Height (CM)

Means of plant height of the 13 grain sorghum genotypes at each environment and all over the six environments are presented in Table 5. The means of plant height of all genotypes ranged from 139.49 cm at Arab El-Awamer in 2013 season to 159.57 cm at Shandaweel in 2012 season. Furthermore, the results showed that the average of plant height across all environments ranged from 113.75 cm for ICSR-89039 to 266.1 cm for SV-1.

Table 5:- Means of plant height of the thirteen grain sorghum genotypes at two locations from 2011 to 2013 seasons.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	168.1	168.0	164.6	172.3	171.4	170.2	169.1
SV-1	270.2	261.7	258.9	268.5	268.7	268.6	266.1
NM- 36565	135.7	135.0	129.1	154.7	154.6	155.2	144.05
ICSR-89028	125.0	123.8	124.8	137.0	136.8	137.2	130.76
R line-924	150.7	150.3	146.9	159.0	160.0	160.0	154.48
ICSR-89016	112.0	103.8	107.3	123.6	125.0	123.8	115.91
ZSV-14	133.5	132.0	131.6	170.2	171.3	169.5	151.35
ICSV-273	133.2	132.4	132.0	134.1	135.3	135.6	133.76
ICSR-89039	108.3	107.0	107.6	119.3	120.9	119.4	113.75
MR-812	135.6	135.7	133.3	159.1	158.6	160.7	147.16
ICSR-93001	146.0	142.5	143.4	160.3	162.0	161.2	152.56
ICSR-93002	144.5	142.9	140.7	167.5	165.9	165.7	154.53
Dorado	97.2	94.8	93.2	145.0	144.0	145.3	119.9
Average	143.07	140.76	139.49	159.27	159.57	159.41	150.26

C- Panicle Length (CM):-

Panicle length means of the 13 grain sorghum genotypes at each environment and across all environments are presented in Table 6. The average of panicle length across all environments ranged from 21 cm. for

ICSR- 93001 to 27.9 cm for Dorado (as a check) and 27.27 cm for SV-1. The mean of panicle length a cross all genotypes ranged from 22.6 cm at Arab El-Awamer in 2012 season to 24.7cm at Shandaweel in 2011 and 2013 seasons.

Table 6:- Means of panicle length (cm) of the thirteen grain sorghum genotypes at two locations from 2011-2013.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	22.17	21.20	23.13	25.87	24.97	25.43	23.79
SV-1	27.20	25.73	28.10	27.50	27.60	27.53	27.27
NM- 36565	21.83	19.97	21.90	25.67	25.10	24.63	23.18
ICSR-89028	23.80	23.40	25.17	23.47	21.57	22.07	23.25
R line-924	27.07	26.57	27.50	24.10	24.63	25.23	25.85
ICSR-89016	25.93	24.43	26.30	24.83	24.03	24.20	24.95
ZSV-14	21.33	20.90	23.37	23.70	23.97	24.53	22.96
ICSV-273	24.97	23.43	25.30	23.83	28.43	27.70	25.61
ICSR-89039	22.30	19.00	21.37	24.23	23.60	23.50	22.33
MR-812	22.33	22.07	22.33	27.47	27.23	26.97	24.73
ICSR-93001	22.30	20.27	22.63	20.23	20.50	20.07	21
ICSR-93002	21.27	20.50	20.90	23.00	21.63	22.90	21.7
Dorado	30.60	26.50	31.00	27.00	26.13	25.93	27.9
Average	24.1	22.6	24.53	24.7	24.6	24.7	24.2

D - Panicle Width (CM):

For Panicle width (cm) means of the 13 grain sorghum genotypes at each environment and across all environments are presented in Table 7. The average of panicle length across all environments ranged from 4.76 cm. for ICSR- 93001 to 6.3 cm for SV-1. The mean of panicle width a cross all genotypes ranged from 5.26 cm at Arab El-Awamer in 2012 season to 6 cm at Shandaweel in 2012 season.

Table 7: Means of panicle width (cm) for 13 grain sorghum genotypes at two locations from 2011-2013.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	5.86	5.46	5.66	5.40	5.60	5.53	5.58
SV-1	6.36	5.86	5.56	6.60	6.76	6.93	6.3
NM- 36565	5.36	5.33	5.53	5.23	5.30	5.00	5.3
ICSR-89028	6.40	6.66	6.06	6.03	6.36	5.93	6.24
R line-924	5.10	5.00	5.40	5.16	5.50	5.83	5.33
ICSR-89016	5.30	5.46	5.06	5.90	6.03	5.43	5.53
ZSV-14	5.56	5.20	6.16	5.66	5.86	5.40	5.64
ICSV-273	5.93	5.86	5.96	6.26	6.00	6.70	6.11
ICSR-89039	5.46	5.06	5.76	6.60	6.73	6.66	6.045
MR-812	4.60	4.73	4.83	6.83	7.03	6.93	5.82
ICSR-93001	4.26	4.20	4.20	5.26	5.20	5.46	4.76
ICSR-93002	4.4	4.6	4.5	6.4	6.5	6.6	5.5
Dorado	5.23	4.96	5.4	4.9	5.1	5.13	5.12
Average	5.37	5.26	5.4	5.9	6	5.96	5.63

E- Grain Yield /Plant:

Means of grain yield per plant for all genotypes across 6 environments and across all environments are presented in Table 8.

The results showed different performances of grain yield per plant of the 13 genotypes from year to year and from location to another. The mean grain yield per plant across all genotypes varied from 21.65 g at Arab El-Awamer in 2012 season to 40.95 g at Shandaweel in 2012 season. Moreover, the results showed that average of grain yield per plant for each genotype across all environments ranged from 6.35 g for R line-924 and ICSV-273 to 51.28 g for NM- 36565. The results also showed different performance of genotypes from year to year and from location to the other.

Table 8:- Means of Grain yield per plant for thirteen grain sorghum genotypes at two locations from 2011 to 2013 seasons.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	6.90	7.43	6.93	7.10	6.93	7.00	7.048
SV-1	7.90	7.40	6.60	7.60	7.30	7.03	7.305
NM- 36565	33.87	31.63	27.17	71.37	72.57	71.07	51.28
ICSR-89028	34.40	32.90	35.40	50.33	52.10	54.10	43.205
R line-924	6.60	6.37	5.97	6.43	6.23	6.50	6.35
ICSR-89016	26.37	25.50	26.93	43.50	44.50	43.27	34.93
ZSV-14	22.83	20.53	21.90	54.60	53.60	55.00	38.07
ICSV-273	5.97	6.03	5.70	6.47	7.20	6.73	6.35
ICSR-89039	29.60	26.33	27.43	59.30	60.50	60.97	44.02
MR-812	30.77	29.17	30.80	55.30	52.43	55.03	42.25
ICSR-93001	32.17	29.77	29.97	48.67	44.87	46.53	38.66
ICSR-93002	36.70	32.57	36.63	53.03	53.60	54.57	44.51
Dorado	24.97	25.87	25.40	63.97	65.13	64.57	44.98
Average	23.003	21.65	22.06	40.59	40.53	40.95	31.45

F- 1000 Grain Weight

The means of 1000 grain weight of the 13 grain sorghum genotypes at each environment and across all environments are presented in Table 9. The results showed different response of genotypes from year to year and from location to another. The average of 1000 grain weight across all environments ranged from 18.9 g for ICSR 93001 to 45.1 g for R line -629. The average of 1000 grain weight cross all genotypes ranged from 24.8 g at Arab El-Awamer in 2012 season to 33.4 g at Shandaweel in 2011 season.

Table 9: Means of 1000 Kernel weight for 13 grain sorghum genotypes at two locations from 2011-2013.

	Arab El-Awamer			Shandaweel			Average
	2010/2011	2011/2012	2012/2013	2010/2011	2011/2012	2012/2013	
Rline -629	32.4	35.8	33.6	55.83	56.43	56.5	45.1
SV-1	33.1	33.7	32.4	56.96	55.57	55.1	44.5
NM- 36565	23.03	20.77	23.83	27.73	28.17	23.03	24.4
ICSR-89028	20.83	18.20	21.33	21.50	21.07	20.83	20.6
R line-924	37.37	36.47	37.70	48.77	48.60	37.37	41.04
ICSR-89016	20.50	19.33	22.33	21.60	21.67	20.50	21
ZSV-14	21.07	18.37	20.03	26.33	25.13	21.07	22
ICSV-273	26.97	29.03	26.43	55.47	55.47	26.97	36.7
ICSR-89039	22.60	23.67	23.37	24.90	24.03	22.60	23.5
MR-812	22.10	22.23	21.70	24.00	24.70	22.10	22.8
ICSR-93001	17.9	19.03	18.06	20.23	20.36	17.9	18.9
ICSR-93002	20.7	21.9	22.2	25	24.9	20.7	22.6
Dorado	24.83	24.30	24.80	26.47	26.33	26.80	25.6
Average	24.9	24.8	25.2	33.4	33.3	28.5	28.4

Estimated Stability Parameters:-

The joint regression analyses for the studied traits are listed in Table 10. The differences among genotypes were highly significant for all the studied traits. The differences among environments and genotypes × environments interaction were highly significant for all traits except panicle length. The genotypes × environments interaction were highly significant for all studied traits (except panicle length) Indicating that genotypes varied considerably across different environments. Furthermore, Environments + (Genotypes × environments) interaction partitions to environment (Linear), genotype × environment interaction (Linear) (sum of squares due to regression, $b_{i)}$ and pooled deviation mean squares, S^2_d. Moreover, the G × E interactions were a linear function, which were significant or highly significant for all the studied traits, except for panicle length. For that reason, the regression coefficient (b_i) and deviation from regression (S^2_d) pooled over the six environments were calculated for each genotype. Significant genotype × environment mean squares for plant height, 1000 grain weight, and grain yield per plant indicate that genotypes were genetically differed in their response to different environments when tested against pooled deviation. Furthermore, no significant pooled deviation for all the study traits. These findings were in agreements with those obtained by Eweis (1998), Ali (2000), Mostafa (2001), Ali (2006), Mahmoud *et al* (2007) and Mahdy *et al* (2011).

Estimates of various stability parameters of the 13 grain sorghum genotypes with respect to days to 50% flowering, plant height, panicle length, panicle width, 1000 grain weight, and grain yield per plant are presented in Tables (11 -13). The stability parameters in these tables are: 1. the average for different characters, 2. the regression coefficient (b_i) of the performance on environmental indices, and 3. deviation from regression (S^2_d). According to the definition of Eberhart and Russell (1966), a stable preferred variety would have approximately: 1. b_i = 1, 2. S^2_d = 0 and 3. a high mean performance.

However, Johnson *et al* (1955), Paroda *et al* (1971) and Lin *el al* (1986) considered the squared deviation from regression as a measure of stability, the regression was regarded as a measure of response of a particular variety to environmental indices.

Table 10. Stability analysis of variance for grain yield and other studied traits of 13 grain sorghum genotypes evaluated under six different environmental conditions.

Source of variation	df	Mean squares					
		Plant hieght	Grain yield	Panicle length	1000 kW	Panicle width	Date flowering
Genotypes	12	8976.7**	1853.4**	26.03**	610.2**	1.285**	49.42**
Env, Env. G	65	154.6**	165.5**	3.016n.s	47.60**	0.336**	44.81**
Env. (linear)	1	6563.1**	6631.9**	55.61**	1400.1**	6.793**	2666.0**
G. Env.(linear)	12	271.7**	335.9**	3.232n.s	136.4**	0.970**	14.06**
Pooled Deviation	52	4.293 n.s	1.793n.s	1.955n.s	1.105n.s	0.065n.s	1.501n.s
Pooled Error	144	8.256	2.593	1.62	2.755	0.066	3.859

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

Table 11. Stability parameters of plant height (cm) and grain yield (g) 13 grain sorghum genotypes evaluated under six different environmental conditions.

	Plant Height(cm)			Grain yield(g)		
Line	Mean ±SE	bi	S^2di	mean±SE	bi	S^2di
1	169.102±0.985	0.243**	-5.908	7.050±0.092	-0.005**	-2.546
2	266.117±1.18	0.303**	6.720	7.306±0.12	0.001**	-2.338
3	119.922±6.04	2.685**	-0.458	44.983±4.76	2.114**	0.678
4	144.050±2.73	1.178	-4.284	51.278±4.98	2.207**	3.758
5	130.756±1.68	0.668**	-6.724	43.206±2.21	0.971	0.115
6	154.472±1.27	0.566**	-6.466	6.350±0.08	0.004**	-2.532
7	115.933±2.15	0.903	-2.093	35.011±2.15	0.944	-1.533
8	151.339±4.71	2.047**	-1.349	38.078±3.99	1.767**	-1.588
9	133.761±0.48	0.134**	-7.735	6.350±.15	0.048**	-2.503
10	113.744±1.67	0.660**	-6.865	44.022±3.97	1.759**	-1.293
11	147.178±3.02	1.327**	-4.517	42.250±3.02	1.299**	-0.586
12	152.572±2.16	0.934	-6.240	38.661±1.99	0.870*	-0.032
13	154.539±2.93	1.283**	-5.605	44.517±2.28	1.000	0.008
Avg.	150.268			31.466		
LSD.05	0.181633			0.117218		
LSD.01	0.240343			0.155107		
SE	0.091734			0.059201		

Regarding plant height, the stability parameters (Table 11) indicated that all the studied genotypes were stable and non-significant S^2d. The bi values of genotypes No. 1, 2, 5, 6, 7,9,10 and 12 showed less than one regression coefficient which were deviating significantly from unity and the deviation from regression (S^2_d) were significant from zero , indicating that these genotypes could be considered stable and adapted to stress environments. Grain yield: The bi values of genotypes 1,2,5,6,7,9,12 and 13 less than one and this result indicated that, these genotypes were stable for stress environments for grain yield. These results are in line with those reported by Mostafa (2001), Mahmoud *et al* (2007), Mahdy *et al* (2011) and Mahmoud *et al* (2012).

Table 12: Stability parameters of panicle length (cm) and 1000-grain yield (g) of 13 grain sorghum genotypes evaluated under six different environmental conditions.

	Panicle length (cm)			1000 KW		
Line	mean±SE	bi	S^2d	mean±SE	bi	S^2d
1	23.794±0.63	2.089	-0.608	45.100±2.77	2.620**	-0.167
2	27.278±0.35	1.121	-1.816	44.467±2.81	2.675**	-0.782
3	27.861±0.54	0.465	4.867	25.589±0.39	0.221**	-2.670
4	23.183±0.55	2.434	0.025	25.494±0.82	0.699**	-1.271
5	23.244±0.40	-0.080	0.445	20.894±0.43	0.187**	-1.145
6	25.850±0.37	-0.552	0.543	42.978±1.44	1.364**	-2.387
7	24.956±0.25	0.283	-0.567	21.367±0.46	0.157**	-1.444
8	22.967±0.38	1.705	-1.201	22.928±0.83	0.733*	-1.574
9	25.611±0.55	1.574	1.561	41.450±3.44	3.280**	-0.119
10	22.333±0.50	2.270	-1.134	23.944±0.26	0.173**	-2.442
11	24.733±0.66	2.312	3.390	23.133±0.31	0.260**	-2.579
12	21.000±0.36	0.307	-0.045	19.333±0.33	0.233**	-2.527
13	21.700±0.27	1.015	-1.103	23.167±0.41	0.367**	-2.340
Avg.	24.193			29.219		
LSD.05	1.538504			0.200098		
LSD.01	2.035798			0.264775		
SE	0.777022			0.101059		

For panicle length in Table 12, the stability parameters indicated that the genotypes varied in their bi values as well as S^2_d. It could be noticed that the regression coefficient (bi) for genotype No. 3,5,6, 7 and 12 were less than one and the deviation from regression (S^2_d) were non-significant from zero for all genotypes indicating that these genotypes would be considered stable for stress environments for panicle length.

Regarding 1000 kernel weight in Table 12, the genotypes 3,4,5,7,8,10,11,12 and 13 were stable for 1000 kernel weight and adapted to stress environments.

For panicle width (cm) in Table 13, data showed that the genotypes 1,3,4,5,6,7,8 and 9 were non-significant s^2d.The bi values for these genotypes were less than one and this result indicated that, these genotypes were stable for stress environments.

For days to 50% flowering, the results indicated that the genotypes 1,3,4,11,12 and 13 was stable for 50% flowering (bi and s^2d were not significant from unity and zero, respectively). The genotypes 3,11,12 and 13 were the best , because they were stable and had decreased days to flowering less than the average of all genotypes.

Table 13: Stability parameters of panicle length (cm) and 1000-grain yield (g) of 13 grain sorghum genotypes evaluated under six different environmental conditions.

	Panicle width (cm)			Days to 50% flowering		
Line	mean±SE	bi	S^2d	mean±SE	bi	S^2d
1	5.589±0.069	-0.210**	-0.038	76.556±1.42	0.960	-2.743
2	6.350±0.13	1.339	0.045	77.167±1.84	1.230**	-2.515
3	5.122±0.065	-0.208**	-0.022	72.667±1.19	0.751**	-2.665
4	5.294±0.069	-0.378**	-0.047	76.778±1.47	0.983	-2.224
5	6.244±0.074	-0.514**	-0.004	76.500±1.60	1.083	-3.457
6	5.333±0.087	0.633	-0.002	78.222±1.63	1.122	-2.786
7	5.533±0.096	0.745	0.026	77.389±2.02	1.363**	-0.536
8	5.644±0.085	0.119*	0.079	78.389±1.68	1.151	-2.024
9	6.122±0.88	0.629	0.004	77.000±1.85	1.258**	-2.305
10	6.050±0.16	2.094**	-0.032	76.333±1.76	1.198*	-2.418
11	5.828±0.27	3.596**	0.011	71.500±0.88	0.562**	-2.419
12	4.767±0.15	1.751*	-0.030	71.667±1.11	0.730**	-1.850
13	5.556±0.24	3.109**	0.005	69.889±0.93	0.601**	-2.717
Avg.	5.649			75.389		
l.sd 0.05	0.68527			0.169304		
l.sd 0.01	0.906772			0.224029		
SE	0.346096			0.085507		

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التفاعل بين الوراثة والبيئة لبعض التراكيب الوراثية لذرة الحبوب الرفيعة تحت ظروف مصر العليا

امل عبدالرحيم تاج ، اعتماد محمد حسين و حاتم ابراهيم على
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أجريت هذه التجربة خلال الموسم الصيفى لأعوام ٢٠١١/٢٠١٠ ، ٢٠١٢/٢٠١١، ٢٠١٣/٢٠١٢ حيث تم تقييم ١٣ تركيب وراثي من الذرة الرفيعة مختلفة المنشأ للحبوب وذلك فى محطتى البحوث الزراعية بكل من عرب العوامر وشندويل وبذلك يكون التقييم تم فى أجمالى ستة بيئات حيث تمت دراسة الصفات التالية:- طول النبات - محصول الحبوب لكل نبات – طول القنديل- عرض القنديل- وزن الألف حبة- ٥٠% تزهير.وتم استخدام البيئات لمعرفة مدى ثبات التركيب الوراثى تحت الظروف البيئية المختلفة.

وأظهر ت النتائج وجود اختلافات عالية المعنوية بين التراكيب الوراثية وبين البيئات وذلك بالنسبة لجميع الصفات محل الدراسة. كما كان تباين التفاعل بين التراكيب الوراثية والبيئات عالى المعنوية أيضا. كما أوضحت النتائج ان التراكيب الوراثية تباينت فى مستواها من سنة لأخرى ومن موقع لموقع.

اظهر تحليل الانحدار المشترك للتباين للصفات التى تم دراستها وجود اختلافات عالية المعنوية بين التراكيب الوراثية وبين البيئات والتفاعل بين التراكيب الوراثية و البيئات لكل الصفات المدروسة وهذا يشير إلى أن التركيب الوراثي يختلف اختلافا كبيرا عبر البيئات المختلفة. وعلاوة على ذلك، فان التفاعل بين التراكيب الوراثية و البيئات (دالة خطية) كان عالى المعنوية لجميع الصفات المدروسة فيما عدا طول القنديل.

أظهرت قيم الثبات (b_i و S^2_d) بالنسبة لصفة محصول الحبوب للنبات أن التراكيب الوراثية تختلف فى قيمتها من حيث b_i وكذلك تختلف فى قيمتها من حيث S^2d. ويمكن ملاحظة أن معامل الانحدار b_i للتراكيب الوراثية ICSR-93002,ICSR-93001,R line-924, ICSR- 89028, ICSR-89016 ICSV-273, Rline-629 SV-1, كان أقل من الواحد الصحيح كما كانت قيمة الانحراف عن الانحدار S^2d غير معنوية عن الصفر وهذا يشير إلى أن هذه التراكيب تعتبر ثابتة بالنسبة لصفة المحصول للبيئات المجهدة وقد احرزت أربعة من هذه السلالات (ICSR- 89028 وICSR-89016 و ICSR-93002 وICSR-93001) محصول حبوب اعلى معنويا من المتوسط العام للسلالات وبالتالي تعتبر سلالات مبشرة.