Stability of Hull-less Barley Genotypes Grown at Different Environments in Egypt

Abdel-Raouf, M.S.[1], A.A. Kandil[1], A.A. El-Sayed[2] and A.M. Attya[2]
[1]Agronomy Department, Faculty of Agriculture, Cairo University, Giza, Egypt.
[2] Barley Research Dep., Field Crops Res. Institute, Agricultural Research Center, Giza, Egypt.

Received on: 3/1/2017 *Accepted: 15/2/2017*

ABSTRACT

Grain yield and its components of 14 hull-less barley genotypes were evaluated in two seasons (2013/2014 and 2014/2015) in five locations (Nubaria, Sakha, Gimmeza, Quntra sharq and Giza) in Egypt. Grain yield ranged from 3.96 to 6.56 t/ha for "L6" and "L3" promising lines. respectively, with grand average of 5.11 t/ha. Giza 135, Giza 136 cultivar L3and L2 promising line produced highest grain yield and its components. On the other hand, the least genotype "L6" in grain yield was had least values in most yield and its components.

Pooled analysis of variance revealed significant effect of S x L interaction and the seasons had greater effect than location, Results also showed significant G x S x L interaction, this means there were differences in relative performance of genotypes over season-location combinations or in other word there were changes genotype x location effect among seasons.

According to stability parameters (bi, S2d, R2, C.V %) and yield average results revealed that L2, L3, L6 promising lines and Giza 135 and Giza 136 showed average stability with general adaptability. However, L8, Giza 129 and Giza 131 were adapted to high yielding environments. On the other side, L4, L5 and L7 promising lines are adapted to low yielding environments.

Key words: *Parameter*, Promising lines, Relationship and Adaptability.

INTRODUCTION

Barley (*Hordeum Vulgare* L.) plants could used as forge, while its grains could useas food, feed and in malt industry. In Egypt, barley is considered a secondary crop in Nile Valley and Delta but it is an important crop in North Coast, north Saini and New Valley. Differences are commonly observed in yield performance over locations and seasons,when barley genotypes are grown at multi-location trials. (Abd-El Ally, 2004; Rico *et al.*, 2007; El-Bawab *et al.*, 2011; EL Sayed *et al.*,2011&2011a; Mühleisen *et al.*, 2014; and Lodhi *et al.*, 2015).

Different performance usually observed when barley genotypes grown under different growing conditions such as soil salinity (Afiah *et al.*, 1999; and Bhutta and Hanif.,2010) , rainfed conditions or irrigation (Noaman *et al* .,2006; EL-Bawab *et al.*, 2011; EL Sayed *et al.*,2011&2011a; Abdel - Raouf *et al.*, 2012 and Lodhi *et al.*, 2015).

Stable cultivars over several environments for high grain yield is important. However, when crop genotypes are tested at different environmental conditions, great differential genotypic expression across environments. For that, the (G E I) is great of value for plant breeder, he can decide to restructure the breeding program to minimize the (G E I) effect or to produce varieties with specific adaption to particular environments. Lodhi *et al.* (2015) stated that the study of the interaction of genotype and environment and yield stability of promising barley genotypes is prerequisite for the development cultivars. He also added that the assessment of stability and wide adaptability of breeding lines against biotic and abiotic stresses is a prerequisite in any breeding program

The first was by Finlay and Wilkinson (1963), who defined stability as the relationship of the genotype yield across environments by the regression coefficient (b_i); where a genotype was considered stable with $b_i= 1$. Eberhart and Russell(1966) further expansion stability measure by using regressiondeviation mean squares (S^2_d). They reported that the genotype stability is expressed in parameters: the mean performance, the slop of regression line (b_i), and the sum of squares of deviation from regression (S^2_d). Therefore, a stable genotype will be with high mean yield over the environments, unit regression coefficient (b_i=1) and deviation from regression equal to zero (S^2_d=0). Pinthus (1973) used the coefficient of determination (R^2) which measures the proportion of a variety's production variation that is due to linear regression.

Kandil *et al.* (1998)in Egypt, tested 13 bread wheat and four durum wheat varieties under conditions of nine environments to study the grain yield stability under irrigation and rainfed conditions in newly reclaimed soils. The three stability parameters, i.e. b_i, S^2_d and R^2 were used, results indicated that durum wheat varieties were stable for grain yield than bread wheat cultivars.

Bahrami *et al.* (2008) They added that the regression coefficient is most useful stability statics which can be applied for selection of hull-less barley genotypes adapted to wide range of environments or adapted to restricted environments.

Lodhi *et al.* (2015) stated that among 105 barley genotypes grown under different 3 environments in India. Only two cultivars were found to be stable for grain yield by meeting all the three parameters of stability over environments. They added that this indicates specific genotypes based on its performance should be recommended for a specific favorable environment. However, Dimitrova-Doneva *et al.* (2016) grown five varieties of winter barley at three locations in Bulgaria in two seasons. They found that location was the most important source of yield variation (59.2%). Environment significantly explained 90.58% (4.4% for year, 59.2 %for location and 26.9%for their interaction) of the total sum of square due to G+E+GEI.

The aim of this investigation was to identify which genotype(s) among the tested 14 genotypes could be grown over different locations and which one suitable for a specific location.

MATERIALS AND METHODS

Ten field experiments were carried out at five locations (Nubaria , Gimmeza , Sakha, Quntra sharq and Giza), Egypt in two successive seasons (2013/2014 and 2014/2015) using 14 genotypes to study theiryield and stability under studied environments.

1- Plant materials

The experimental materials for the study consisted of 14 barley genotypes. These genotypes are 9 promising lines (L1, L2, L3, L4, L5, L6, L7, L8 and L9), three cultivated varieties Giza 129, Giza 130, Giza 131 and two new varieties Giza 135 and Giza 136. Name, pedigree and origin of studied genotypes are given in Table1.

2- Description of the experiment sites.

The description of the experiment sites including soil analysis, location and meteorological data are presented in Tables 2, 3 and 4, respectively.

Table 1: Pedigree / name and seed origin of 14 -6 –rowed, hull-less genotypes.

Name	Name / Pedigree	Origin*
L1	GIZA 129/ HIPROLY	Egypt
L2	GIZA 130/10/ APETO/5/GLORIA-BAR/4/SOTOL// 2762/BC-B/3/11012.2/TERN-B/6/H272 /7/SEN/8/MJA/9/PETUNIA 1/10/CABUYA	Egypt
L3	GIZA 2000/11/ APETO/5/GLORIA-BAR/4/SOTOL// 2762/BC-B/3/11012.2/TERN-B/6/H272 /7/SEN/8/MJA/9/PETUNIA 1/10/CABUYA	Egypt
L4	GIZA 2000/5/LIGNEE640/PI382798//DC-B/3/CABUYA/4/PETUNIA 1	Egypt
L5	CARDO/LINO//CHINIA/3/ALISO/4/CI3909-2/5/FALCON-BAR/6/HIGO	Egypt
L6	GIZA 117/6/ GLORIA-BAR/COPAL//PM5/3/BEN/4/ SEN/5/PETUNIA 1	Egypt
L7	GIZA 126/3/ CABUYA/MJA//PETUNIA 1	Egypt
L8	GIZA 126/6/ P.STO/3/LBIRAN/UNA80//LIGNEE640/4/BLLU/5/PETUNIA 1	Egypt
L9	GIZA 131//PETUNIA 1/CHINIA	Egypt
GIZA 129	Deir Alla106/Cel//As 46/Aths*2	Egypt
GIZA 130	CC229//Bco.Mr./DZ02391/3/Deir Alla106	Egypt
GIZA 131	CM67-B/CENTENO//CAM-B/3/ROW906.73/4/GLORIA-BAR/COME-B/5/FALCON-BAR/6/LIN	Egypt
GIZA 135	ZARZA/BERMEJO/4/DS4931//GLORIA-BAR/COPAL/3/SEN/5/ANYAROSA	Egypt
GIZA 136	PLAISANT/7/CLN-B/4/S.P-B/LIGNEE640/3/S.P-B//GLORIA-BAR/COME-B/5/FALCON-BAR/6/LINO	Egypt

* Barley Res.Dept., FCRI, ARC

Table 2: Mechanical and chemical analysis of locations soil* .

Location	Available(ppm)			PH	Ec	$CaCo_3$	Clay	Silt	Sand	Soil texture*
	N	P	K		dc/m	%	%	%	%	
Nubaria	54.2	2.6	290	8.2	5.4	22.8	11.5	24.6	63.9	Sandy Loam
Sakha	66.8	8.0	430	8.1	3.0	1.32	54.4	9.20	36.3	Clay Loam
Gimmeza	53.2	18.6	490	7.7	2.01	3.86	39.6	41.8	18.6	Clay
Q. sharq	45.0	6.6	144	7.8	1.09	1.23	7.6	2.1	90.3	Sandy
Giza	65.0	8.6	335	7.8	1.15	1.43	50.6	38.3	11.5	Loam

* These analysis were done by soil and water Research Institute, ARC, Egypt.

Table 3: Location and elevation of data for the experiment sites.

Site	latitude	longitude	Altitude
Nubaria	31 12 N	29 57 E	7 m
Sakha	31 07 N	30 57 E	10 m
Gimmeza	30 48 N	31 07 E	9 m
Quntra sharq	31 17 N	32 27 E	14 m
Giza	30 02 N	31 13 E	22 m

Table 4: Meteorological data of the experiment sites.

	2013/2014					2014/2015				
	Nub.	Sak.	Gim.	Q.sharq	Giza	Nub.	Sak.	Gim.	Q.sharq	Giza
					December					
Average tem.(c)	14.9	15.2	14.2	15.3	15.2	16.4	15.4	15.9	17.1	19
Average rainfall (mm)	36.6	61.6	54.3	19	8	43	77.3	50.7	20.6	6
Av. Relative humidity (%)	74	96	92	80	68	69	90	88	73	56
Av. Wind speed (m/sec)	2.2	3.2	2.9	3.1	1	1.7	2.9	2.7	2.6	1.5
Av. Sunshine duration (hr)	10	10.1	10	10	10.1	10	10.1	10	10	10.2
					January					
Average tem.(c)	14.6	14.6	13.9	16.1	15.5	13.6	14.2	13.7	14.2	15.8
Average rainfall (mm)	12	13.3	11.7	8.6	3	12.6	22	18.9	9.1	4..0
Av. Relative humidity (%)	80	94	94	89	66.6	66.7	90	88	71.3	54.3
Av. Wind speed (m/sec)	1.4	3.7	3.5	2.5	1.5	2.9	3.9	3.2	3.5	2.1
Av. Sunshine duration (hr)	10.2	10.3	10.2	10.2	10.3	10.2	10.2	10.2	10.2	10.5
					February					
Average tem.(c)	15.6	16.2	16.8	16.5	16.9	14.1	15.8	13.4	14.4	16.3
Average rainfall (mm)	6.1	18.2	16.5	7.6	1.9	22.7	17.9	14.6	8.1	2
Av. Relative humidity (%)	75	61	76	82	60.9	67	63	59	71.3	53.2
Av. Wind speed (m/sec)	2.1	2.8	3.7	3.1	2.1	3.1	3.1	3.7	3.6	2.2
Av. Sunshine duration (hr)	11.1	11.2	11.3	11	11	11	11.1	11.3	11	11
					March					
Average tem.(c)	17	17.4	16.3	17.6	19.1	16.9	17.6	16.6	17.6	21
Average rainfall (mm)	2.9	12.6	24.6	6.3	10	2.1	10.2	3.6	2.4	4
Av. Relative humidity (%)	70	84	86	83	60.4	66.3	88	83	73.3	51.6
Av. Wind speed (m/sec)	2.5	3.1	2.7	3.8	2.9	2.7	3.4	3.3	3.7	2.3
Av. Sunshine duration (hr)	11.8	11.8	11.7	11.8	11.8	11.8	11.8	11.8	11.8	11.5
					April					
Average tem.(c)	19.8	20.4	18.6	20.3	23.5	18.2	19.6	18	18.5	23.6
Average rainfall(mm)	0	5	10.2	3.5	0	3.7	6.3	10	2.9	0
Av. Relative humidity (%)	70	83	82	74	59.4	64.3	82	77	72	43.1
Av. Wind speed (m/sec)	2.2	2.9	2.9	3.6	2.9	3.1	3.3	3.1	4.3	2.7
Av. Sunshine duration (hr)	12.8	12.8	12.9	12.8	12.8	12.8	12.8	12.9	12.8	12.4
					May					
Average tem.(c)	23	23.5	24.1	23.3	27	22.3	23.8	24.3	22.4	28.7
Average rainfall (mm)	0	0	0	5	0	0	0	0	2	0
Av. Relative humidity (%)	63	81	77	65	52.8	63.7	83	80	69	41.6
Av. Wind speed (m/sec)	2.7	2.8	2.7	3.4	2.7	2.8	2.9	2.8	3.9	2.5
Av. Sunshine duration (hr)	13.4	13.4	13.5	13.6	13.5	13.6	13.4	13.5	13.6	13.5

The cultural practices which carried out in each location in the two seasons are shown in Table 5.

Table 5: Cultural practices carried out in different locations in the two seasons.

	Nubaria	Sakha	Gimmeza	Quntra sharq	Giza
2013/2014					
Seeding date	Dec., 1st week	Dec., 1st week	Dec., 1st week	Dec., 1st week	Dec., 1st week
Seeding rate (kg/fedd.)	50	50	50	50	50
Row spacing (cm)	20	20	20	20	20
N Level (kg/fedd.)	70	70	70	70	70
N Source	Urea	Urea	Urea	Urea	Urea
Irrigation System	Surface	Surface	Surface	Sprinkler	Surface
Number of Irrigations	3	3	2	4	2
Harvesting date	Mid- May	Mid- May	Mid- May	Mid- May	Mid- May
2014/2015					
Seeding date	Dec., 1st week	Dec., 1st week	Dec., 1st week	Dec., 1st week	Dec., 1st week
Seeding rate (kg/fedd.)	50	50	50	50	50
Row spacing (cm)	20	20	20	20	20
N Level (kg/fedd.)	70	70	70	70	70
N Source	Urea	Urea	Urea	Urea	Urea
Irrigation System	Surface	Surface	Surface	Sprinkler	Surface
Number of Irrigations	3	3	2	4	2
Harvesting date	Mid- May	Mid- May	Mid- May	Mid- May	Mid- May

3. Statistical analysis

Normality distributions in each environment were checked out by the Wilk Shapiro test (Neter *et al* 1996). An analysis of variance (ANOVA) was done for each environment separately. A combined analysis of variance was done from the mean data of each environment, to create the means for the different statistical analyses methods. Homogeneity test of variances were performed according to procedures reported by Gomez and Gomez (1984).

To evaluate the stability of tested genotypes across the eight environments, parametric stability statistics were used to estimate stability in this study. Five stability parameters were performed. The first and second were proposed by Eberhart and Russell (1966), i.e. the slope value (b_i) and deviation from regression parameter (S^2_{di}). The third was coefficients of determination (R_i^2) by Pinthus (1973). The fourth one was coefficient of variation (CV_i) by Francis and Kannenberg's (1978), besides mean performance across environment ($\bar{x}_i$).

The regression coefficient and genotype mean were used together as a measure for adaptation (Finlay and Wilkinson, 1963 and Bilbro and Ray, 1976). Genotype with b_i=1.0 was considered adapted for all environments, genotype with b_i <1.0 was considered adapted for low yielding environments and cultivar with b_i >1.0 considered adapted for high yielding environments depending on genotype mean.

Coefficient of determination R^2(Pinthus, 1973) was used as another parameter of stability. Also, coefficient of variability (C.V.%) was used as an agronomic measure of performance stability of genotypes. The high value of C.V% indicate low stability in performance and *vice versa*. All statistical analyses were carried out using MSTAT-C software package (Freed et al 1989), GENE's computer software (Cruz, 2013) and MS Excel.

RESULTS AND DISCUSSION

Analysis of variance

Combined analysis of variance for grain yield is presented in Table (6). Results of combined analysis showed that differences among environments were highly significant for grain yield, indicating that the ten environments (E) are different in their conditions. Also, significant (p<0.05) mean squares due to genotypes (G) and GEI were detected for grain yield, which indicated that genotypes performed differently at different environments.

Mean performance:

Data in Table 7 show the mean performance of the tested 14 hull-less barley genotypes overall locations and seasons. The grain yield (t/ha) ranged from 3.96 to 6.56 t/ha for "L6" and "L3",respectively. With grand average of 5.11 t/ha. Giza 135, Giza 136 cultivar and L2 promising line produced grain yield on bar with that of L3 promising line (Table 7).

Data in Table 7 show that the highest four genotypes in grain yield were L3, L2, Giza 136 and Giza 135.On the other side, the least genotype "L6" in grain yield was observed in most locations in both seasons.

With regard to yield in different locations overall seasons and genotypes, Table (7) shows that Sakha and Gimmeza produced highest grain yield t/ha (6.04 and 5.93). The advantage of both locations may be due to its favorable conditions, i.e. soil characters and climate factors for growing hull-less barley. On the other hand, Quntra sharq location was the least location with lower values of grain yield (Table 7). This may be due its less favorable conditions of this location.

Table 6: Combine analysis of variance for yield and its components of 14 hull-less barley genotypes in 10 environments

S.V	d.f	Mean squares
		GY
Environments	9	1110.16**
Rep/ environments	20	27.32
genotypes	13	53.41*
Env. × genotypes	117	42.76*
Pooled error	260	1.19

*, ** significant at 0.05 and 0.01 probability level, respectively.

Table 7: Mean grain yield (ton/ha)for 14 barley genotypes and their combined means across ten environments

Genotypes	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	combined
L1	5.21	6.57	6.43	2.57	5.00	3.86	5.57	5.86	2.86	4.71	4.86
L2	6.44	7.29	7.29	3.72	6.43	5.86	6.29	7.00	3.57	5.71	5.96
L3	6.56	7.57	7.29	4.79	7.00	6.86	7.43	7.39	4.14	6.57	6.56
L4	6.43	5.57	5.00	1.57	3.79	7.14	6.43	5.43	2.29	4.71	4.84
L5	4.93	5.00	4.71	1.96	2.86	4.00	5.57	5.14	2.43	4.43	4.10
L6	3.29	5.71	5.29	2.19	4.14	4.00	4.86	4.43	2.14	3.57	3.96
L7	4.36	6.07	4.57	1.76	7.14	3.14	5.29	4.57	3.86	6.29	4.70
L8	4.57	6.14	6.71	2.92	3.71	5.00	6.14	6.71	3.00	5.71	5.06
L9	6.29	4.86	5.71	1.98	3.71	4.86	4.57	5.71	1.86	4.29	4.38
Giza 129	6.05	6.00	5.71	3.64	4.57	5.86	6.29	5.71	4.86	4.71	5.34
Giza 130	4.82	6.14	5.86	3.12	4.29	3.00	6.71	5.86	3.14	4.50	4.74
Giza 131	5.29	5.43	5.86	4.24	4.79	4.71	5.57	6.14	4.29	4.29	5.06
Giza 135	5.79	6.00	6.57	4.89	6.07	6.00	6.00	5.71	5.00	5.83	5.79
Giza 136	6.50	6.86	7.00	5.14	6.43	6.00	7.00	6.43	5.00	5.71	6.21
mean	5.47	6.09	6.00	3.18	4.99	5.02	5.98	5.86	3.46	5.07	5.11
L.S.D. 5% (E G)	0.83										

(E1 & E6)= Nubaria, (E2 & E7)= Sakha, (E3 & E8)= Gimmeza, (E4 & E9)= Quntra sharq, (E5 & E10)= Giza.

Stability of tested genotypes

Pooled analysis of variance for grain yield across the ten environments is presented in Table (8). The results revealed that there were significant differences among the tested genotypes for grain yield, which suggested that the genotypes differed considerably with respect to yield performance. Joint regression analysis of variance showed that the mean squares due to genotypes (G), environments (E) and GEI were highly significant for grain yield, indicating the presence of wide variability among the genotypes as well as environments under which the experiments were conducted. The significant estimates of GEI indicated that grain yield was unstable and may considerably fluctuate with change in environments. These findings are in close agreement with those of Amin *et al* (2005), Aycicek and Yildirim (2006), Ülker *et al* (2006), Rasul *et al* (2006), Akcura *et al* (2009), Parveen *et al* (2010), Al-Otayk (2010), El-Ameen (2012) and Mohamed *et al* (2013).

Table 8: Joint regression analysis of variance for grain yield of the 14 genotypes tested in ten environments

S.O.V	d.f	Mean squares	P-value
Total	139	11.56	
Environments (E)	9	39.52**	0.001
Genotypes (G)	13	23.42**	0.001
G×E	117	5.78**	0.001
E + (G×E)	126	3.14**	0.001
Environment(Linear)	1	379.17**	0.001
G×E (Linear)	13	2.11**	0.001
Pooled deviation	112	2.34**	0.001
Pooled Error	260	2.19	

** significant at 0.01 probability level.

Significant environment (linear) variance implies linear variation among environments for grain yield. The G x E (linear) interaction was significant against pooled deviation, suggesting the possibility of the variation for grain yield and indicated the presence of genetic differences among genotypes for their regression on the environmental index (Table 8). The linear component of GEI was found to be more than the non-linear component (pooled deviation). These results are in consistent with those of Mohamed *et al* (2013) who have reported predominance of linear component of GEI for grain yield per plant.

Stability and adaptation parameters:

The parameters estimated to evaluate the relative stability of hull-less barley genotypes over the range of environmental conditions are presented in Table 9.

According to Eberhart and Russell (1966) results in Table 9 and Figures 1 and 2 indicated that L2, L3, L6 promising line and Giza 135 and Giza 136 cultivar could be considered stable genotypes because their (b_i) value did not differ significantly from unity and their (S^2_d) values did not differ significantly from zero for grain yield. These findings were assessed by high values ≥ 0.75 for coefficient of determination (R^2), except L6 line for grain yield (0.57 t/ha). This means the linear regression was good fits to the actual values of grain yield for stable genotypes with high (R^2) value.

With regard tocoefficient of variability (C.V) Table 9 show L2, L3, L6 promising lines and Giza 135 and Giza 136 was consider stable because they had low (C.V %) for yield .

With regard to adaptation of the tested genotypes and according to Finlay and Wilkinson (1963), the L2, L3 promising lines and Giza 135 and Giza 136 varieties had average stability with a general adaptability for grain yield, because they had (b_i) value near unity and mean performance more than the grand mean (Tables7 and 9).

Table 9: Stability parameters for grain yield of 14 hull-less barley genotypes over 10 environments.

Genotypes	$\overline{X}$	(bi)	(S2di)	(R2i)	(C.V %)	Fr
L1	4.86	1.35**	2.65*	0.66	2.64	1
L2	5.96	1.05	0.07	0.93	1.46	5
L3	6.56	1.03	0.04	0.96	1.00	5
L4	4.84	0.46*	0.93	0.55	3.31	1
L5	4.10	0.19*	1.87*	0.71	3.86	1
L6	3.96	1.10	0.09	0.57	3.31	3
L7	4.70	0.31*	0.54	0.56	3.13	1
L8	5.06	1.35**	2.92*	0.72	2.64	1
L9	4.38	1.31**	1.12	0.53	3.98	1
Giza 129	5.34	1.11	1.71*	0.80	4.81	3
Giza 130	4.74	1.25*	1.21*	0.84	3.77	1
Giza 131	5.06	1.62**	1.16*	0.90	2.38	1
Giza 135	5.79	1.10	0.67	0.92	2.02	4
Giza 136	6.21	1.09	0.04	0.92	1.50	5

*,** Significantly different from 1.0 for the regression coefficients and from 0.0 for the deviation mean squares at the 0.05 and 0.01 levels of probability , respectively. Fr. =frequency of the number of stability parameters showing stability for each genotype, if a genotype had seven values of Fr., it could be considered most stable.

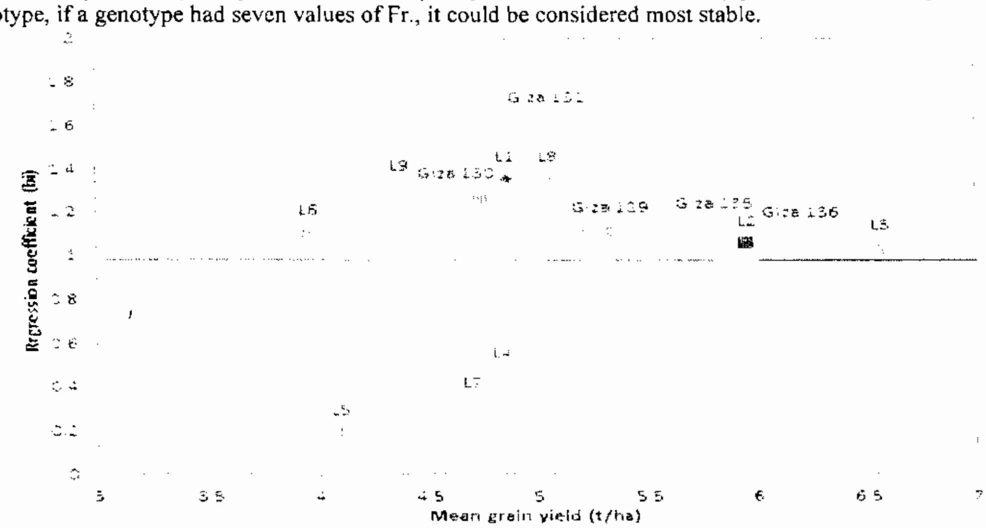

Fig. 1: Mean grain yield and regression coefficients of 14 barley genotypes tested across 10 different environments.

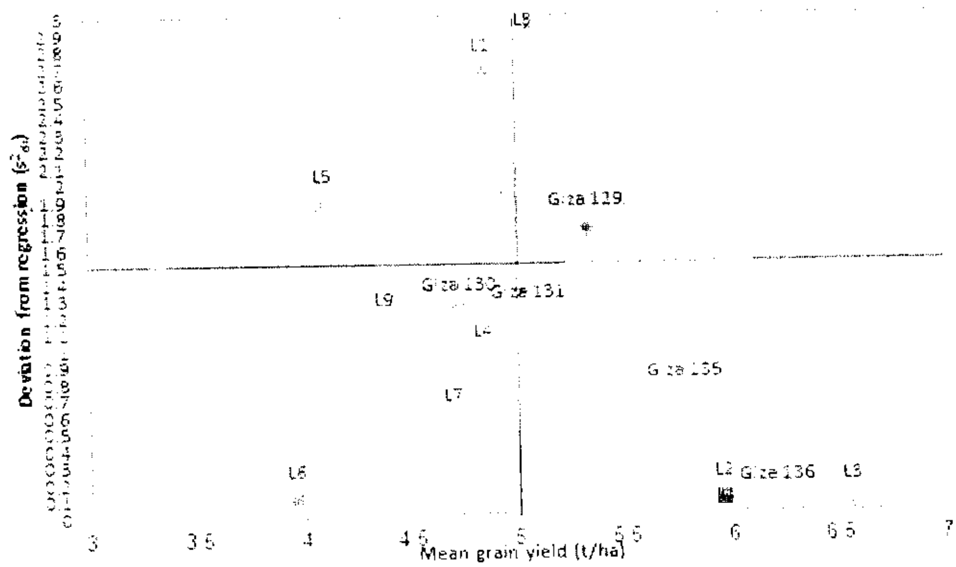

Fig.2: Mean grain yield and deviation from regression of 14 barley genotypes tested across 10 different environments.

On the other hand, L6 promising line had average stability with a general adaptability for low grain yield The adapted genotypes to high yielding environments, i.e. which have (b_i) value > 1 Finlay and Wilkinson (1963) are L8, Giza 129 and Giza 131 for grain yield t/ha (Table 9 and Figure 1).

On the other hand, the adapted genotypes to low yielding environments, i.e. which low (b_i) value < 1 are L4, L5 and L7 promising lines for grain yield t/ha (Table 9 and Figure 1).

CONCLUSION

Pooled analysis of variance revealed significant effect of S x L interaction and the seasons had greater effect than location, Results also showed significant G x S x L interaction, this means there were differences in relative performance of genotypes over season-location combinations or in other word there were changes genotype x location effect among seasons.

According to stability parameters (b_i, S^2_d, R^2, C.V %) and yield average results revealed that L2, L3, L6 promising lines and Giza 135 and Giza 136 showed average stability with general adaptability. However, L8, Giza 129 and Giza 131 were adapted to high yielding environments. On the other side, L4,L5 and L7 promising lines are adapted to low yielding environments.

REFERENCES

Abd-El-Ally, A. B. M. (**2004**). Evaluation of Some Barley Genotypes for Earliness under the New Valley Conditions. M.Sc. Thesis, Fac. Agric., AL-Azhar Univ., Egypt.

Abdel-Raouf, M.S., A.A. Kandil, A.A. El-Sayed and A.M. Attya(**2012**). Evaluation of some barley genotypes under soil moisture stress. Egypt J. Plant Breeding, **16(2)**: 121-134.

Afiah, S. A. N.,H. A. Sallam and S. A. M. Khattab (**1999**). Evaluation of divergent barley (*Hordeum vulgare* L.) genotypes under certain environments. Annals Agric. Sci., Moshtohor, **37(2)**: 973-988.

Akcura, M., Y. Kaya and S. Taner (**2009**). Evaluation of durum wheat genotypes using parametric and nonparametric stability statistics. Turk. J. Field Crops **14**: 111-122.

Al-Otayk, S.M. (**2010**). Performance of yield and stability of wheat genotypes under high stress environments of the Central Region of Saudi Arabia. Met. Env. Arid Land Agric. Sci. **21**: 81-92.

AL-Soudan I.H. (**2011**). Performance of some barley genotypes under different environments. M.Sc. Thesis Fac., Agric., cairo, Univ. Egypt.

Amin, M., T. Mohammad, A. J. Khan, M. Irfaq, A. Ali and G.R. Tahir (**2005**). Yield stability of spring wheat (*Triticum aestivum* L.) in North West Frontir province, Pakistan. Songklanakarin J. Sci. Technol. **27**: 1147-1150.

Aycicek, M. and T. Yildirim (**2006**). Adaptability performances of some bread wheat (*Triticum aestivum* L.) genotypes in the Eastern Region of Turkey. Int. J. Sci. Technol. **1**: 83-89.

Bahrami, S.,M. R. Bihamta, M. Salari,M. Soluki, A. Ghanbari, A. A. Vahabi Sadehi and A. Kazemipour (**2008**). Yield stability analysis in hulless barley (*Hordeum vulgare* L.). Asian J. Plant Sci., **7**: 589-593.

Bilbro, J. D. and L. L. Ray (**1976**). Environmental stability and adaptation of several cotton cultivars. Crop Sci., **16**: 821– 824.

Bolandi A., A. A. Imani, H. Shahbazi and Asghar Mehraban (**2012**). The study of compatibility and stability of grain yield in barley advanced genotypes in tropical and subtropical reinfed regions. Annals of Biological Research, **3** (**12**): 5540-5544.

Bhutta, W. M. and M. Hanif (**2010**). Genetic variability of salinity tolerance in spring wheat (*Triticum aestivum* L.). Plant Soil Sci., **60** (**3**): 256-261.

Cruz, C.D. (**2013**). GENES-a software package for analysis in experimental statistics and quantitative genetics. Acta Scientiarum, **35**(**3**): 271-276.

Dimitrova-Doneva, M.,D.Valcheva, G. Mihova and B. Dyulgerova (**2016**). Genotype-environment Interaction and stability analysis for grain yield of winter barley in the conditions of North-East and South Bulgaria. Agric. Sci. and Technology, vol. **8**, No 1, pp , 19 – 23.

Eberhart, S. A. and W. A. Russell (**1966**). Stability parameters for comparing varieties . Crop. Sci. **6**: 36-40.

El-Ameen, T. (**2012**). Stability analysis of selected wheat genotypes under different environment conditions in Upper Egypt. Afr. J. Agric. Res. **7**: 4838-4844.

El-Bawab. A. M. O. (**2002**). Stability of different barley genotypes for yield and some agronomic characters. Egypt. J. Appl. Sci. **17** (**9**): 118-129.

El-Bawab , A.M.O, R.A. Abo El-Enein, F. Karajeh and M.F.S. Abd El-Rahman (**2011**). Productivity of newly released barley cultivars in on farm demonstration trials applied on new lands and rainfed areas of Egypt. Egypt. J. Plant Breed. **15** (**5**): 137 – 147.

El-Sayed, A. A.,A.M. O. El-Bawab, M.A. El Moselhy, M. A. Magahed, kh A. Amer, H. A. Ashmawy, M. Z. Shendy, Sh. Abaas, A.A. Eid, M. A. Mahmoud,A. A. Badawy, Stifania Grando, A.F. Capettini,E.K. Gendy,A.M Elkaramany, E.E. Mostafa and A. Mohamed (**2011**). Giza 135 a new adapted hull-less barley variety for all barley production areas in Egypt J. Plant Breeding **15** (**2**): 81-95.

El-Sayed, A. A., A.M. O. El-Bawab, M.A. El Moselhy, M. A. Magahed, kh A. Amer, H. A. Ashmawy, M. Z. Shendy, Sh. Abaas , A.A. Eid, M. A. Mahmoud, A. A. Badawy, Stifania Grando, A.F. Capettini, E.K. Gendy, A.M Elkaramany, E.E. Mostafa and A. Mohamed (**2011a**). Giza 136 Anew high yielding and stable hull-less barley variety for irrigated areas in Egypt J. Plant Breeding **15**(**2**): 39-50.

El-Sayed, A. A.; Haggag, M. E. A.; El-Hennawy, M. A. and Shendy, M. Z. (**2007**). Stability of some exotic hull-less barley genotypes across variable environments in Egypt .Egypt. J. Plant Breed., **11**(**2**): 751-758.

Finlay, K. W. and G. N. Wilkinson (**1963**). The analysis of adaptation in plant breeding program. Aust. J. Agric. Res.**14**: 742-754.

Francis, T. R. and L. W. Kannenberg (**1978**). Yield stability studies in short-season maize.1. A descriptive method for grouping genotypes. Can. J. Plant. Sci. **58**:1029-1034.

Freed, R.,S. P.Einensmith, S. Gutez, D. Reicosky, V. W. Smail and P. Wolberg (**1989**). Guide to MSTAT-C Analysis of Agronomic Research Experiments. Michigan State University, East Lansing, USA, 152 p.

Gomez, A. K. and A. A. Gomez (**1984**). Statistical Procedures for Agricultural Research. John Wiley and Sons. New York, USA.

Kandil, A. A.,A. A. Hoballah and Hayam, Mahgoub, S. (**1998**). Grain yield stability of some Wheat cultivars grown under irrigation and rainfed conditions in reclaimed soils. Proc. 8 th Conf. Agron., Suez Canal Univ., Ismailia, Egypt, 28-29 Nov. pp 19- 27.

Lodhi R.D., L.C. Prasad, S.S. Bornare, A.H. Madakemohekar and R. Prasad (**2015**). Stability analysis of yield and its component traits of barley (*Hordeum vulgare* L.) genotypes in Multi- Environmenttrials in the North Eastern plains of India.Sabro Journal of Breeding and Genetics 47 (**2**): 143-159.

Mohamed S. H., G.I.A. Mohamed and R. A. R. El-Said (**2013**). Stability analysis for grain yield and its components of some durum wheat genotypes (*Triticum durum*) under different environments. Asian J. of Crop Sci. **5**(**2**): 179-189.

Mühleisen, J., H.P. Piepho, H.P. Maurer, Y . Zhao and J.C. Reif, (**2014**). Exploitation of yield stability in barley. Theor. Appl. Genet. ;**127**(**9**): 1949-62.

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

Noaman, M. M.,A. A. El-Sayed, R. A. Abo-El-Enein, I. A. Ahamed, A. S. EL-Gamal, M. EL-Sherbiny, M. M. Abo-EL-Hameed, M. A. Megahed, M. A. Moselhy, A. M. O. El-Bawab, Kh. A. Amer, M. F. Saad, H. A. Ashmawy, R. A. Rizk and Y. M. Abdel Tawab (**2006**). (Giza132) A new drought tolerant six-rowed barley cultivar. Egypt. J. Appl. Sci., **21**(**8**): 46-56.

Parveen, L., I. H. Khalil and S. K. Khalil (**2010**). Stability parameters for tillers grain weight and yield of wheat cultivars in North-West of Pakistan. Pak. J. Bot. **42**: 1613-1617.

Pinthus, J. M. (**1973**). Estimate of genotype value: a proposed method. Euphytica, **22**: 121-123.

Rasul, I., M. Zulkiffal, J. Anwar, S.B. Khan, M. Hussain and R. Din (**2006**). Grain yield stability of wheat genotypes under different environments in Punjab. J. Agric. Soc. Sci. **2**: 222-224.

Rico, M.C.,V. M. Z. Villa, A. J. I. Rya, G. M. Zambranot and M. A. T. Tapia (**2007**). Characterization and selection of new awn less forage barley genotypes for northern and central Mexico. Tec Pecu Mex., **45(3)**: 249-262.

Steel, R. G. D. and J. H. Torrie (**1980**). Principles and Procedures of Statistics, Second Edition, New York: McGraw-Hill.

Ülker, M., F. Sönmez, V. Ciftci, N. Yilmaz and R. Apak (**2006**). Adaptation and stability analysis in the selected lines of tir wheat. Pak. J. Bot. **38**: 1177-1183.

الملخص العربي

الثبات الوراثى لبعض التراكيب الوراثية من الشعير العارى المنزرعه فى مناطق مختلفه فى مصر

محمد صبرى عبد الرووف[١]، عبد العزيز قنديل أحمد[١]، عبد الفتاح احمد السيد[٢]، احمد ماهر عطيه[٢]

[١] قسم المحاصيل – كلية الزراعة – جامعة القاهرة – الجيزة – جمهورية مصر العربية

[٢] قسم بحوث الشعير – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعية – الجيزة – جمهورية مصر العربية

الشعير احد المحاصيل الحقلية القديمه وله استخدامات كثيرة منها تغذية الانسان والحيوان وصناعة المولت وغيرها، ويستخدم البدو فى المناطق الصحراويه دقيق الشعير فى صنع الخبز بدلا من دقيق القمح، ولكن المشكله التى تواجه مزارعى الشعير هى نقص انتاجية الاصناف المنزرعه حاليا.

وتهدف الدراسة الى تحديد افضل التراكيب الوراثيه المتاحه للزراعه فى المواقع تحت الدراسة من حيث انتاجها للحبوب ودرجة ثبات انتاجيتها، ونظرا لحاجة بعض شركات الصناعات الغذائيه للشعير العارى لاستخدامه فى بعض منتجاتها، وعدم كفايه الناتج منه فى مناطق زراعته بالاراضى المطريه، فتهدف الدراسه الى تحديد افضل التراكيب الوراثيه للزراعه المرويه فى الدلتا لتلبيه حاجة الشركات من الشعير العارى.

وقد استخدم فى هذه الدراسة ١٤ تركيب وراثى فى موسمى (٢٠١٤/٢٠١٥ – ٢٠١٣/٢٠١٤) فى خمس مناطق (النوبارية، سخا، الجميزه، القنطره شرق، الجيزه)، واوضحت النتائج ثبات السلالات ٢، ٣، ٦ فى المحصول ومكوناته وكذلك جيزه ١٣٦ و جيزه ١٣٥ من الاصناف الجديدة وذلك تحت اربع معايير للثبات الوراثى، وقد اعطت السلالاتان ٢، ٣ وجيزه ١٣٦ وجيزه ١٣٥ اعلى محصول على عكس السلالة ٦ والتى اعطت اقل محصول مقارنه بمتوسط عام الاصناف.

وأشارت الدراسه الى ثبات محصول السلالات L2, L3, L6 والصنفين جيزه ١٣٥ وجيزه ١٣٦، كما اظهرت تأقلم عام طبقا لمعايير الثبات والتأقلم تحت الدراسة، كما وجد ان السلالة L8 والصنفين جيزه ١٢٩ وجيزه ١٣١ متأقلمه للبيئات عالية الانتاجية بينما كانت السلالات L4, L5, L7 متأقلمه للبيئات الاقل انتاجية.

كما اظهرت النتائج على الرسم البيانى بقرب السلالتين ٢ و٣ وكذلك جيزه ١٣٦ وجيزه ١٣٥ من خط الانحدار بما يعنى ثباتهم الوراثى وكذلك وقوعهم فى الجزء الخاص بارتفاع المحصول، اما السلالة ٦ فهى قريبه من خط الانحدار ولكن محصولها منخفض، اما باقى التراكيب الوراثية فى بعيدة عن خط الانحدار.

وكذلك فى منحنى التشتت عن خط الانحار فنجد قرب السلالتين ٢ و٣ والصنف جيزه ١٣٦ اما الصنف جيزه ١٣٥ فهو بعيد عن خط التشتت اما باقى التراكيب الوراثية فهى بعيدة عن خط التشتت وتختلف فى توزيعها حسب كمية المحصول.