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STABILITY PARAMETERS OF GRAIN YIELD AND ITS COMPONENTS FOR SOME PARLEY GENOTYPES

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ABSTRACT

High and stable yield is very desirable in barley (*Hordeum vulgare L.*) genotypes .The experiment of this study was conducted in eighteen environments (three locations , three K rates and two seasons) . The three locations used are El-Serw , Noubaria and Hossienia all of them have salty soils . Two season; 2009/ 2010 and 2010/2011 using eight genotypes of barley. The experiments were grown in a split-split blocks design with three replications in each location. The objectives of this study were to increase barley productivity and adaptability under different conditions by identifying and developing genotypes that are more adapted and more stable in production under these harsh environments. The combined analysis of variance for environment (E), genotypes (G) and GE interaction was significant suggesting differential response of the genotypes and the need for stability analysis. The stability measures are useful in characterizing genotypes by showing their relation performance in various environments. Results revealed that high yielding cultivars can also be stable cultivars. The genotype 4 followed by genotype 1 and genotype 2 were the most stable for grain yield because their regression coefficients were the highest, b_i value almost near unity and they had lower deviations from regression; these would be recommended for 18 environmental conditions.. These genotypes could be considered as wide adaptive genotypes.

The regression coefficient (b_i) and deviation of regression (S^2_d) displayed highly significant positive correlation with phenotypic variance and coefficient of variation. In contrast, the insignificant correlation coefficients among the other stability parameters were found. Moreover, the mean grain yield displayed positive correlation with phenotypic variance and regression coefficient, but there was negative correlation with coefficient of variation and deviation of regression.

INTRODUCTION

Barley (*Hordeum vulgare L.*) is considered one of the most adapted cereals to environmental conditions especially water stress, are not suitable for growing other cereal crops. Ceccarelli,(1984) stated that barley is the most important cereal crop in marginal, low-input and drought stress environments. Stability analysis for growth, yield and yield attributing traits are very important from the point of stable production of barley.

Genotype x Environment interactions pose major problem in developing new cultivars and in choosing suitable cultivars to grow in specific region /location. Relative ranking of genotypes often differ when compared over several locations or environments, making it difficult to identify the most suitable genotype. This interaction is present whether the varieties are pure lines, single crosses or double cross hybrids, top crosses, S_1 lines or any material with which breeder may be working (Eberhart and Russell, 1966).

Phenotypically stable genotypes are of great importance, because the environmental condition varies from year to year/region to region. Wide adoption to the particular environment and consistent performance of recommended genotypes is one of the main objectives in breeding programme. Although a number of varieties have been recommended for the cultivation, the information on the stability is lacking for the agro-climatic conditions of Egypt. So there is necessity to evaluate and screen the potential genotype giving consistent performance over different years and to select the genotypes on the basis of stability parameters for important yield and maturity attributes (Kalloo, 1998).

Genotype × Environment interaction force the breeder to choose between developing widely adaptable cultivars or cultivars adapted to limited subsets of environment (Jinks and Pooni, 1982). Lines selected for high yield in high yielding environment have above average environmental sensitivity, while selection for high yield in below average environment results in lines with above average stability (Jinks and Pooni, 1982).

The objective of this study was to evaluate growth, yield and yield components traits magnitude and stability; find quality differences between the genotypes and years; find influence of environment and genotype; identify most stable genotypes and locations; grouping of the genotypes by quality and finding out correlations between the stability parameters in barley.

MATERIALS AND METHODS

Three field experiments were conducted at three experemental farms of filed crops Res. Jnst. During 2009/2010 and 2010/2011 seasons representing barley production areas in Egypt. Using the eight genotypes of six rowed barley these genotypes consists of two cultivars and six lines. Table (1) show the name and pedigree of the tested barley genotypes. The objectives of this research were to evaluate these genotypes for their yield productivity and other morphological characteristics in an attempt to characterize and identify from those entries which could be adapted and more suitable to be grown under each environment. The three sites selected to represent wide range of agroclimatologial parameters, as well as different soil types could be classified as follows :-

I- **old lands** :-

1- Hossienia South Plain Agr. Exp. Sta. in El-Sharkia governorate (North East Delta) , where the soil texture is clay .

2- El-Serw Agri. Exp. Sta. in Damietta governorate (North Delta) , where the soil texture is clay loam .

II- New lands :-

The sites were selected as follows :-

The Noubaria Agri. Exp. Sta. in El-Behera governorate (West Delta) , soil texture is sandy loam .

The soils of these sites suffer from the severe lack in organic matters, humus , nutrient macro and micro elements.

Recommended calcium super phosphate (15.5% p_2 05) was applied during land preparation for each location. Potassium sulphate as a side dressing in two equal doses. The firest one was applied during to seed bed preparation and the second was added before Mohayah irrigation.

Nitrogen fertilizer was added at the rate of 45 kg N/fed in the old land sites in three equal doses the first was added before sowing, the second was added before Mohayah irrigation and the last was added before heading.

The service irrigation system was used in the other three old land sites (Hossienia South Plain, El-Serw and Noubaria) the irrigation was applied as recommended in each site. The afir method of planting was used and the normal cultural practicies were followed as used for ordinary area.

A split -plot design with three replications was maintained for each location. Each experiment included 24 treatments comprising three potassium levels and eight barley genotypes. The main plots were assigned to three potassium fertilizer rates in (zero, 24and 48 kg. k20 /fad). The sub plots were occupied with eight barley genotypes. The experimental plot area was 10.5m^2 (3m × 3.5 ml.) there were 15 rows in each plot spaced 20cm. apart.

Analysis of variance:

Data were statistically analyzed as a split -plot design and comparison among treatments means using the least significant differences (L-S. D) test at 5% level of probabilities according to Steel and Torrie (1980). Combined analysis over all environments were done for all characters according to Snedecor and Cochran (1980).

The pedigree record of these genotypes of barley (Horduem vulgare, L.), were used and their names and origins are presented in Table (1).

Table (1) : Pedigree and origins' of 8 barley genotypes six rowed.

Ser No.	pedigree	ORIGIN
1	(Alanda)//Lignee527//Arar/5/Ager//Api/CM67/3/Ce1/W12269//Ore/4/Hhammao1/6/Alanda-o1//Gerbe1/Hama/5/Chn-o1/3/Arizona5908/Aths//Bgs/4/Lignee640/Bgs//Cel	ICARDA
2	(M64)-76/Bonn//Jo/York/3M5/Galt//As46/4/Hj34-80/Astrix/5/NK1272/6/Giza121	ICARDA
3	(Alanda)//Lignee527//Arar/3/Alanda-01	ICARDA
4	(U.Sask.)1766/Api//Cel/3/Weeah/4/Giza121/Pue	ICARDA
5	(Giza119)/5/ROD586/Nopl "S"/3/PmB / Aths // Bc/4/F2 CC33 MS/Cl0755	EYGPT
6	(Giza119)/5/ROD586/Nopl "S"/3/PmB / Aths // Bc/4/F2 CC33 MS/Cl0755	EYGPT
7	Giza 123 -------	EYGPT
8	Giza 2000 --------	EYGPT

Data recorded and variables studied :-

At maturity to minimize border effect, the middle five adjacent rows were used to record the vegetative growth characters in the filed and harvested in each plot to estimate the grain yield and its components

I-Vegetative growth attributes:
height (PLH) in cm: average of plant height for five plants/plot.
Number of tillers (NT)/ m2 . No.of tellers average of plant tellers for m2 /plot.
Heading date (H.D): Number of days from sowing to 50% heading/plot.
Maturity Date (MD): Number of days from sowing to 50% maturity/plot.
Spike length (SPL), in cm: average of five main spikes/plot.
II- Yield and yield component :
Biological yield (By) (ton/fed) .
Straw yield , (ST) ton/fed.
Number of spikes/m2 (NSP/m2) .
Number of kernels per spike (K/S): Average of five main spikes/plot.
Grain weight /spike): Average of five main spikes/plot.
Seed index : 1000 – kernels weight : Average of five samples/plot.
Grain yield in ardab/fed.
Harvest index (HI) : grain yield divided by biological yield.
Stability analysis:

To analyze the data over three environments (locations) the stability model proposed by Eberhart and Russell (1966) was used.
With this model, the variation due to environments, genotype x environments were partitioned into environments (linear), genotype x environments (linear) and deviation from the regression coefficients.

Source of Variation	d.f	Mean Square
Genotypes	(t – 1)	MS_1
Environments + (G x E)	t(s – 1)	
Environments (linear)	1	
Genotypes x Environments (linear)	(t – 1)	MS_2
Pooled deviation	t(s – 2)	MS_3
Pooled error	s(r – 1)(t – 1)	M_e

Where,
r = replications
Me= Mean square for pooled error
'F' test

a) To test the significance of the difference among the genotype means.

$$F = \frac{MS_1}{MS_3}$$

b) To test that genotypes do not differ for their regression on the environmental index.

$$F = \frac{MS_2}{MS_3}$$

c) To test the individual deviation from linear regression.

$$F = \frac{\sum_j \sigma^2_{ij}}{n-2} \text{ / Pooled error}$$

A joint consideration of the three parameters, that is
i) The mean performance of the genotype over the environments, X_i

ii) The regression coefficient b_i.
iii) The deviation from linear regression S^2_d, is used to define stability of genotype.

For the regression analysis of variance, the residuals from the combined analysis of variance were used as a pooled error to test the S^2_d values. A significant F value would indicate that the S^2_d was significantly different from zero. The hypothesis that each regression coefficient equaled unity was tested by t test using the standard error of the corresponding b value.

Correlations between mean grain yield and stability parameters.

Correlation analysis was used to study the relationship between mean yield *per se* and stability parameters, as well as between studied stability parameters. Correlation coefficients were compared against table r-values given by Fisher and Yates (1953) at (n-2) degrees of freedom at the probability levels of 0.05 and 0.01 to test their significance.

RESULTS AND DISCUSSION

Stability analysis:

An experiment comprising of eight barley genotypes was carried out to assess stability of genotypes over eighteen different environments on different traits. The results obtained from the present investigation are presented as follows:

1-* Analysis of variance and mean performances*:

Genotype x environment interactions are important sources of variation in any crop and the term stability is sometimes used to characterize a genotype, which shows a relatively constant yield, independent of changing environmental conditions (Becker and Leon, 1988**)**.

Pooled analysis of variance for 8 barley cultivars through 18 environments are presented in Table (2). Pooled analysis of variance exhibited highly significant mean squares ($P < 0.01$) due to the genotypes, environments and genotypes x environments for plant height, number of tillers, heading date, number of grains/spike, grains weight/spike, 1000-grain weight, number of spikes/m^3 and harvest index. Concerning, MD, straw yield, biological yield, spike length and grain yield traits displayed highly significant mean squares ($P < 0.01$) at genotypes and environments. The genotypes x environment interactions were significant for yield and yield components traits (Chand *et al*., 2008).

Significant differences were observed among barley cultivars for grain yield, 1000-grain weight, plant height and heading date (Mut *et al*., 2010). The significant estimates of G x E interaction indicated that the characters were unstable and may considerably fluctuate with change in environments (Chand *et al*., 2008).

These results indicated the presence of variability among genotypes as well as environments under which the experiments were conducted. Therefore, an understanding of genotypes x environments interaction provides valid insights towords the selection of new stable genotypes in the diversified environmental conditions prevailing in a region.

The results of the combined analysis of stability are given in Table (3). An analysis of variance for stability revealed highly significant differences ($P < 0.01$) for all studied traits among genotypes and environments + (genotypes x environments). This reveals that not only the amount of variability existed among environments but also indicates the presence of genetic variability among the genotypes.

The sum of squares due to environments and genotype x environment are partitioned into environments (linear), genotype x environment (linear) and pooled deviation (nonlinear) from the regression model. The highly significance ($P < 0.01$) of these components showed that both predictable and unpredictable components shared genotypes x environments interactions.

Environments (linear) demonstrated highly significant for all studied traits, while, the genotypes x environments (linear) interaction showed highly significant for all studied traits except spike length (significant), number of tillers, grains weight/spike and number of spikes/m^3 traits (insignificant). The genotypes x environments (linear) interaction had highly significant (tested against pooled deviation) which demonstrated that genotypes respond differently to variation in environmental conditions and indicating existence of differences among the regression coefficients. Simin *et al*., (1986), Afiash *et al*., (1999), Mohamadi *et al*., (2005) and Chand *et al*., (2008) reported that, the genotypes x environments (linear) interaction was significant against pooled deviation suggesting the possibility of the variation for yield and yield components traits.

The mean squares of stability analysis cleared that, highly significant for number of tillers, number of grains/spike, grain weight/spike, 1000-grain weight and number of spikes/m2 traits, and significant ($P < 0.05$) for heading date and harvest index traits of pooled deviations were found. However, another studied traits were insignificant. The pooled deviations were highly significant against pooled error, showing that the differences in stability were due to deviation from linear regression only. Further, the variation in stability of different cultivars performances was mainly due to genotypes by environment interaction.

The analysis of variance of 8 genotypes claimed that traits manifested significant or highly significant. i.e. the genotype 1 for grains weight/spike and 1000-grain weight traits, genotype 2 for number of grains/spike, grains weight/spike and 1000-grain weight traits, the genotypes 3 and 8 for heading date, number of grains/spike, grains weight/spike and 1000-grain weight traits, the genotype 4 for number of tillers, heading date, grains weight/spike, 1000-grain weight and number of spikes/m^3 traits, the genotype 5 for heading date, the genotype 6 for grains weight/spike, 1000-grain weight traits, grain yield and harvest index traits and the genotype 7 for plant height, number of tillers, number of grains/spike, 1000-grain weight and number of spikes/m^2 .

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Analysis of variance showed that the mean sum of squares due to genotypes and environment difference tested against the genotypes x environment interactions were significant for all the studied traits, indicating the presence of wide variability among the genotypes and environment (Mohamadi *et al*., 2005 and Chand *et al*., 2008).

Mean performances:

Calculated mean performances for studied traits of eight genotypes during eighteen environments are presented in Table (4). The genotypes displayed different levels of performance across the tested eighteen environments and studied traits**.** Grand mean of plant height, number of tillers, heading date, MD, straw yield, biological yield, spike length, number of grains/spike, grains weight/spike, 1000-grain weight, number of spikes/m^2, grain yield and harvest index traits were 90.24, 322.41, 94.12, 132.99, 3.33, 4.71, 6.19, 50.70, 2.16, 40.67, 304.56, 11.50 and 29.25, respectively. Three genotypes for plant height, number of tillers, MD, biological yield, grains weight/spike and number of spikes/m^3 traits and four genotypes for other studied traits except 1000-grain weight (five genotypes) gave higher values than the grand means for grand means.

Genotype 4 had the highest values across all environments for plant height, number of tillers, straw yield, biological yield, spike length, grains weight/spike, 1000-grain weight, number of spikes/m^3, grain yield and harvest index traits were 102.48, 391.35, 3.77, 5.47, 7.78, 3.22, 51.17, 373.43, 14.15 and 31.06, respectively. However, the genotype 5 gave the poorest performance across all the environments for previous studied traits which values were 82.85, 279.22, 2.93, 4.02, 5.04, 1.45, 31.72, 261.44, 9.12 and 27.19, respectively. The genotype 5 recorded the best values during all environments for heading date, MD and number of grains/spike were 86.76, 126.30 and 60.35, respectively. While, the minimum value for number of grains/spike was 40.65 in genotype 4. The performance of all other genotypes was moderately well in all environments. According to Eberhart and Russell (1966), an ideal cultivar would have both a high average performance over a wide range of environments plus stability. The high yield performance of released genotypes is one of the most important targets of breeders; therefore, they prefer a dynamic concept of stability (Becker and Leon, 1988).

2- Stability parameters:

Phenotypic variance (σ^2_P), coefficient of variation (C.V. %), regression coefficient (b_i) and deviation from regression (S^2_d) for the 8 genotypes ranged from 0.60 (genotype 5 for grains weight/spike) to 28143.88 (genotype 4 for number of tillers), from 3.29 (genotype 4 for harvest index) to 100.20 (genotype 7 for plant height), from -0.15 (genotype 6 for harvest index) to 3.14 (genotype for 1000 -grain weight) and from -66.34 (genotype 3 for number of tillers) to 665.99 (genotype 4 for number of tillers), respectively. The large variation in mean grain yield, $\sigma^2_{P,}$ C.V. %, bi and S^2_d indicated different responses of genotypes to environmental changes.

Phenotypic variance (σ^2_P):

The results of phenotypic variance for eight genotypes during eighteen environments are illustrated in Table (5). Grand mean of σ^2_P were

416.84, 18836.6, 683.13, 352.07, 6.5, 13.10, 10.64, 176.48, 1.36, 303.36, 17.264.98, 79.73 and 4.28 for plant height, number of tillers, heading date, MD, straw yield, biological yield, spike length, number of grains/spike, grains weight/spike, 1000-grain weight, number of spikes/m^3, grain yield and harvest index traits, respectively. Plant height, heading date, number of grains/spike and harvest index traits revealed that four genotypes recorded greater values than the grand means. As for, three genotypes for number of tillers, biological yield, spike length, number of spikes/m^3 and grain yield traits and tow genotypes for other studied traits gave higher values than the grand means for phenotypic variances.

The maximum values of phenotypic variance across environments were recorded of genotype 1 for grains weight/spike and 1000-grain weight traits, genotype 3 for heading date, genotypes 4 for number of tillers and number of spikes/m3 traits, genotype 5 for MD and spike length traits, genotype 6 for straw yield, biological yield, grain yield and harvest index traits, genotype 7 for plant height trait and genotype 8 for number of grains/spike trait. On the other hand, the minimum values of phenotypic variance during all environments were detected for number of tillers, MD and number of spikes/m3 traits at genotype 2, for plant height, heading date and harvest index traits at genotype 4, for straw yield, biological yield, number of grains/spike, grains weight/spike and grain yield traits at genotype 5 and for spike length and 1000-grain weight traits at genotype 7.

In general, some genotypes with very close average studied traits had different phenotypic variances. These closer magnitudes suggested that the greater role of variability is due to the environmental conditions. These results detected that, the genotypes with a minimal variance for yield across different environments are considered stable. This idea of stability may be considered as a biological or static concept of stability (Becker and Leon, 1988). This concept of stability is not acceptable to most breeders and agronomists, who prefer genotypes with high mean yields and the potential to respond to agronomic inputs or better environmental conditions (Becker, 1981).

Coefficient of variations (C.V. %):

The coefficient of variations of eight genotypes and eighteen environments for different traits are given in Table (6). The results claimed that, the grand mean of C.V. % for plant height, number of tillers, heading date, MD, straw yield, biological yield, spike length, number of grains/spike, grains weight/spike, 1000-grain weight, number of spikes/m^3, grain yield and harvest index traits were 71.7, 42.26, 27.55, 13.97, 76.44, 76.66, 52.54, 25.90, 52.90, 37.83, 42.80, 77.61 and 6.91, respectively. Five genotypes for plant height and number of tillers traits, four genotypes for heading date and harvest index traits, two genotypes for MD, straw yield and spike length traits, three genotypes for biological yield, grains weight/spike, 1000-grain weight and grain yield traits and six genotypes for number of grains/spike and number of spikes/m^3 traits gave higher values than the grand means for coefficient of variations.

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Genotype 1 for number of tillers, grains weight/spike, 1000-grain weight and number of spikes/m^3, genotype 5 for heading date, MD and spike length, genotype 6 for straw yield, biological yield, grain yield and harvest index traits, genotype 7 for plant height trait and genotype 8 for number of grains/spike trait differed from the other genotypes by higher C.V. % values. With respect to, the genotype 1 for heading date trait, the genotype 2 for plant height trait, the genotype 3 for number of tillers and number of spikes/m3 traits, the genotype 4 for straw yield, biological yield, spike length, grains weight/spike, grain yield and harvest index traits, the genotype 5 number of grains/spike trait, the genotype 7 1000-grain weight trait and the genotype 8 for MD trait had lower C.V. %. These results suggested that the genotype 4 recorded the minimum values of C.V. %, it may be possible to select simultaneously for high and stable grain yield by selecting outyielders that exhibit a low C.V. %. Mustãţea1 *et al*., (2009) stated that, plotting C.V.'s against average yield proved to be the most useful tool in identifying cultivars with high and stable yield.

Regression coefficient (b_i):

The regression coefficient of studied traits at eight varieties and eighteen environments are given in Table (7). Grand mean of b_i for all studied traits in this study and any study were 1.00. Five genotypes for plant height, number of grains/spike and harvest index traits, four genotypes for number of tillers, heading date, biological yield, 1000-grain weight and grain yield traits and three genotypes for MD, straw yield, spike length, grains weight/spike and numbers of spikes/m^3 traits in b_i gave higher values than the grand means for the regression coefficient. The variations in regression coefficient (b_i) values suggested that the eight genotypes responded differently to the different environments.

The regression coefficient (b_i) values of the eight genotypes used in this study exhibited no genotype with b-values equal to 1.00 except the genotypes 4 and 5 had b values equal to one (1.00) for number of tillers and plant height traits, respectively. The regression coefficient values of genotypes 1 and 2 for straw yield (1.03 and 1.02), biological yield (1.03 and 1.02) and grain yield (1.05 and 1.02) respectively, the genotype 3 for number of grains/spike (1.04), the genotype 4 for MD (1.01), biological yield (0.96), number of spikes/m^3 (0.99) and grain yield (0.99), the genotype 5 for 1000-grain weight (1.10) and number of spikes/m3 (0.99), the genotype 6 for heading date (0.96), MD (0.98) and spike length (0.99), the genotype 7 for harvest index (1.06) and the genotype 8 for plant height (1.05), number of tillers (1.03), spike length (1.01), grains weight/spike (1.01), number of spikes/m3 (1.05) and grain yield (1.04) were close to unity. Hence, these genotypes may be considered as stable genotypes for previous traits.

Five genotypes for number of grains/spike and harvest index traits, four genotypes of plant height, heading date, straw yield, biological yield, 1000-grain weight and grain yield traits and three genotypes for number of tillers, MD, spike length, grains weight/spike and number of spikes/m^3 traits out of eight genotypes had regression coefficients above unity, while other genotypes expressed b values below unity at these traits. Regression values above 1.00 describe genotypes with higher sensitivity to environmental change (below average stability) and greater specificity of adaptability to high yielding environments.

The yields of these lines were significantly affected by varying environmental conditions and yields increased when the conditions were adequate and decreased below average when the conditions were inadequate. Variability among environments is an important factor and mostly determines the usefulness of b values (Ülker *et al*., 2006).

Deviation of regression (S^2_d):

The stability parameter deviation of regression for eight genotypes and eighteen environments are shown in Table (8). Grand mean of S^2_d were -0.88, 73.43, 0.73, -0.43, -0.01, -0.01, -0.0 1.7, 0.03, 6.6, 7.57, -0.06 and 0.05 for plant height, number of tillers, heading date, MD, straw yield, biological yield, spike length, number of grains/spike, grains weight/spike, 1000-grain weight, number of spikes/m^3, grain yield and harvest index traits, respectively. These results indicated that, straw yield, biological yield, spike length, grains weight/spike, grain yield and harvest index traits showing stability over wider range of environments. The genotypes displayed a wide range of values for S^2_d for grain yield.

When deviation from regression (S^2_d) is as small as possible it could be taken as the measure of genotypic stability over a set of environments. The values, although smallest for straw yield, biological yield, spike length, grains weight/spike, grain yield and harvest index traits were found at all studied genotypes.

The genotype 1 for number of tillers, heading date and number of spikes/m3 traits, variety 4 for plant height, spike length and grains weight/spike traits, genotype 5 for MD, straw yield, biological yield, number of grains/spike, grains weight/spike and grain weight traits, genotype 7 for grains weight/spike, 1000-grain weight and harvest index traits and genotype 8 for spike length and grains weight/spike traits gave low S^2_d values which show better stability and specific adaptation to favorable environments.

On the other hand, the genotype 3 for 1000-grain weight, genotype 4 for number of tillers and number of spikes/m3 traits, genotype 5 for heading date, genotype 6 for MD, genotype 7 for plant height and genotype 8 for number of grains/spike had high S^2_d, indicating less stability and indicating sensitivity to environmental changes. Due to the high values of S^2_d, these genotypes are expected to give good yield under favorable environmental conditions. Deviation from regression as small as possible is the measure of genotypic stability across a set of environments (Abdul Majid *et al*., 2007). Deviation of regression (S^2_d) are the most appropriate criterion for measuring phenotypic stability in an agronomic sense, because this parameter measures the predictability of genotypic reaction to environment; with high and desirable *per se* performance of a variety across environments is also a positive point to rate the variety as a better and highly stable genotype Baker (1988) .

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Accordingly, most cultivars show comparatively minimum value for S^2_d and a b_i value close to unity and hence, it may be considered stable for these traits studied in low yielding environments. The above stability parameters also favor cultivar 4 for its stability in high yielding environments. The genotype 4 ($\bar{x}$ = 14.15, b_i = 0.99 and S^2_d = -0.16) followed by genotype 1 ($\bar{x}$ = 12.18, b_i = 1.05 and S^2_d = -0.11) and variety 2 ($\bar{x}$ = 12.02, b_i = 1.02 and S^2_d = -0.22) were the most stable for grain yield because their regression coefficients were the highest, b_i value almost near unity and they had lower deviations from regression; these would be recommended for 18 environment conditions. Genotypes with high mean yield, a regression coefficient equal to the unity (b_i = 1) and small deviations from regression (S^2_d = 0) are considered stable (Finlay and Wilkinson, 1963 and Eberhart and Russell, 1966). Parveen *et al*. (2010) noticed some cultivars as stable on the basis of overall mean yields and stability parameters *viz*., regression coefficients and minimum deviations from regression. Feiziasl, *et al*. (2010); Kadi *et al.,* (2010); Mut *et al*., (2010) and Hristov *et al*. (2011) considered that a desirable genotype with stability and above average grain yield should have a regression line with a positive intercept and slope equal to 1.0 and lower deviation from regression.

3- Correlations between mean grain yield and stability parameters:

The correlation coefficients among the mean grain yield and stability parameters are presented in Table (9). The regression coefficient (b_i) and deviation of regression (S^2_d) displayed highly significantly positive correlation with phenotypic variance (0.99) and coefficient of variation (0.83), respectively. In contrast, the insignificant correlation coefficients among the other stability parameters were found. Moreover, the mean grain yield displayed positive correlation with phenotypic variance (0.36) and regression coefficient (0.46), but it were negative correlation with coefficient of variation (-0.51) and deviation of regression (-0.32). However, positive correlation coefficients were observed between phenotypic variance and coefficient of variation (0.62), phenotypic variance and deviation of regression (0.61), coefficient of variation and regression coefficient (0.52) as well as regression coefficient and deviation of regression (0.48), but these correlations were statistically non-significant.

Table (9): Correlation coefficients between mean grain yield and the studied stability parameters

S^2_d	b_i	C.V. %	σ^2_P	Mean	Stability Parameters
-0.32	0.46	-0.51	0.36	1.00	Mean
0.61	0.99**	0.62	1.00		σ^2_P
0.83**	0.52	1.00			C.V. %
0.48	1.00				b_i
1.00					S^2_d

Despite existence of several highly significant correlations, it is obvious that each stability parameter and especially those belonging to different groups according to Mustăţea1 *et al*., (2009) describe different aspects of genotypes x environment interaction. Mut *et al*., (2010) reported that, statistically insignificant and positively or negatively correlation were detected between mean grain yield and regression coefficient (24.70), mean grain yield and deviation of regression (-2.60) as well as regression coefficient and deviation of regression (53.50).

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تقدير الثبات المظهري للمحصول ومكوناته في بعض التراكيب الوراثية للشعير

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يعتبر الشعير من محاصيل الحبوب الرئيسية وخاصة في مساحات الأراضى التي لا يجود فيها زراعة القمح لاستغلاله المساحات المتأثرة بالملوحة في مصر والتي تزداد عاما تلو الآخر.و يتم ذلك عن طريق استخدام بعض التراكيب الوراثية المبشرة تحت ظروف الملوحة واختيار أفضلها لكل منطقه أوعلى مستوى هذه المناطق.

أجريت هذه الدراسة بغرض تقدير الثبات المظهري للمحصول ومكوناته في ثمانية عشر بيئة (ثلاثة مناطق، ثلاث مستويات تسميد بوتاسي و موسمين) خلال موسمي2010/2009 و2011/2010 وقد استخدم في البحث ثمانية تراكيب وراثية و-ثلاث مناطق هى: (السرو ، النوبارية ، الحسينية) و ثلاث مستويات تسميد بوتاسيوم (0بدون تسميد k2o, 24 كجم k2o / فدان و48 كجم0 k2o /فدان) وقد صممت التجربة في تصميم القطع المنشقة مرة واحدة في ثلاث مكررات في كل موقع ودونت البيانات علي صفات طول النبات سم ، عدد الأفرع /م2 ، موعد طرد السنابل ،موعد النضج ، طول السنبلة سم ، عدد السنابل /م2 ،عدد حبوب السنبلة، وزن حبوب

السنبلة جم ، وزن 1000 حبة جم ، محصول الحبوب إردب/فدان ، محصول القش بالكيلوجرام /الفدان، المحصول البيولوجي بالكيلوجرام /الفدان و دليل الحصاد.

أوضحت النتائج وجود فروق معنوية بين التراكيب الوراثية في الشعير في شكلها المظهري وقدرتها الإنتاجية وذلك تحت قدرات التعبير في بيئات مختلفة وكذلك وجود فروق معنوية ترجع إلي البيئات والتفاعل بين البيئات والتراكيب الوراثية عند تحليل التباين المشترك ، وهذا يبرهن علي وجود اختلافات في استجابة التراكيب الوراثية مما يعني الحاجة إلي تحليل الثبات المظهري حيث أن قياس الثبات يكون مفيدا في توصيف التراكيب الوراثية ودراسة سلوكها الوراثي في البيئات المختلفة.

اظهرت التجارب أن التركيب الوراثي يمكن أن يعطي محصولا جيدا وأيضا ثباتا مظهريا في البيئات المختلفة . وقد بين التحليل الإحصائي باستخدام طريقة "ابراهرت ورا سيل" أن التراكيب الوراثية المدروسة ذات درجة عالية من الثبات المظهري وكان التركيب الوراثي الرابع ثم التركيب الوراثي الأول والثاني أكثر التراكيب الوراثية ثباتا في البيئات المختلفة بالإضافة إلي إعطائه محصولا جيدا. وقد بينت نتائج التحليل أيضا أن هذه التراكيب الوراثية ذات تأقلم واسع تحت الظروف البيئية المدروسة فيها.

أظهرت قياسات معامل الإرتباط أيضا أن معامل الإنحدار(b_i) والإنحراف عن الإنحدار (S^2_d) ارتبطت ارتباطا موجبا وعالي المعنوية مع التباين المظهري(σ^2_P) ومعامل الاختلاف علي التوالي , ولم يكن هناك أي اختلاف معنوي لمعامل الإرتباط علي مقاييس الثبات الأخرى . وعلاوة علي ذلك فإن متوسط محصول الحبوب كان مرتبطا ارتباطا معنويا وموجبا مع التباين المظهري ومعامل الإنحدار ولكنه كان مرتبطا ارتباطا سلبيا مع الإنحراف عن الإنحدار (S^2_d) ومعامل الإختلاف (*C.V. %*).

قام بتحكيم البحث

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Table (2): Pooled analysis of variance for studied traits in eight barley genotypes grown in eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/ spike	No. of grains /spike	Spike length	Biology yield	Straw yield	MD	HD	No. of Tillers	Plant height	d.f	Traits / Genotypes
62.77**	110.97**	61509.00**	1593.75**	13.74**	1616.12**	34.73**	9.97**	3.65**	926.05**	759.33**	61594.81**	1975.23**	7	**Genotypes (G)**
1.50**	106.45**	20800.95**	132.24**	0.83**	163.11**	11.77**	17.54**	8.71**	468.63**	875.18**	23006.44**	5625.99**	17	**Environments (E)**
0.65**	0.87	510.45**	42.29**	0.15**	12.29**	0.47	0.14	0.07	4.06	12.75**	512.27**	46.74**	119	**G x E**
0.35	0.79	221.26	3.26	0.03	4.52	0.44	0.13	0.07	3.41	6.64	221.85	10.38	288	**Error**

Table (3): Combined analysis of stability for studied traits in eight barley genotypes grown in eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/ spike	No. of grains/s pike	Spike length	Biology yield	Straw yield	MD	HD	No. of Tillers	Plant height	d.f	Traits / Genotypes
20.92**	36.99**	20503.00**	531.25**	4.58**	538.71**	11.58**	3.32**	1.22**	308.68**	253.11**	20531.60**	658.41**	**7**	**Genotypes (G)**
0.25**	4.69**	1015.59**	17.84**	0.08**	10.38**	0.63**	0.77**	0.38**	20.71**	40.18**	1108.02**	248.05**	**136**	**Env. +(G.xEnv.)**
8.53**	603.24**	117872.03**	749.35**	4.72**	924.29**	66.67**	99.40**	49.37**	2655.57**	4959.36**	130369.81**	31880.62**	**1**	**Env. (Linear)**
0.66**	1.20**	216.89	105.26**	0.07	10.69**	0.28*	0.21**	0.11**	10.13**	18.38**	207.98	217.62**	**7**	**G x Env (Linear)**
0.16*	0.21	146.32**	7.35**	0.04**	3.22**	0.13	0.03	0.02	0.70	2.95*	147.38**	2.58	**128**	**Pooled devation**
0.07	0.15	63.49	14.88**	0.11**	0.27	0.12	0.02	0.01	1.20	1.12	67.17	0.77	**16**	**Variety 1**
0.14	0.04	10.57	3.81**	0.04**	6.43**	0.19	0.01	0.00	0.67	0.25	10.33	2.62	**16**	**Variety 2**
0.14	0.22	8.09	16.66**	0.06**	4.27**	0.13	0.03	0.02	0.45	5.13**	7.61	1.69	**16**	**Variety 3**
0.05	0.11	737.55**	3.12**	0.02**	0.36	0.14	0.02	0.01	0.49	4.83**	739.94**	4.21	**16**	**Variety 4**
0.19	0.23	15.79	0.63	0.01	1.04	0.10	0.05	0.03	1.12	6.77**	15.45	0.88	**16**	**Variety 5**
0.43**	0.49*	11.47	8.14**	0.07**	0.77	0.09	0.06	0.03	0.43	0.32	11.87	2.55	**16**	**Variety 6**
0.11	0.20	313.77**	0.81	0.02**	5.66**	0.11	0.03	0.01	0.82	0.87	316.32**	6.21*	**16**	**Variety 7**
0.20	0.19	9.86	10.75**	0.02*	6.99**	0.15	0.03	0.02	0.45	4.28*	10.33	1.74	**16**	**Variety 8**
0.12	0.26	73.75	1.09	0.01	1.51	0.15	0.04	0.02	1.14	2.21	73.95	3.46	**288**	**Pooled Error**

Table (4): Mean performences for studied traits in eight barley genotypes on eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/spike	No. of grains/spike	Spike length	Biology yield	Straw yield	MD	Heading date	No. of Tillers	Plant height	Traits / Genotypes
29.20	12.18	325.74	42.72	2.32	52.63	5.78	5.00	3.54	132.41	93.15	343.44	89.31	**1**
29.85	12.02	291.87	40.98	2.14	51.41	5.63	4.83	3.39	132.02	94.04	309.69	92.00	**2**
29.31	10.77	313.56	41.43	2.26	52.48	6.41	4.41	3.12	132.15	93.80	331.48	85.80	**3**
31.06	14.15	373.43	51.17	3.22	40.65	7.78	5.47	3.77	141.39	100.46	391.35	102.48	**4**
27.19	9.12	261.44	31.72	1.45	60.35	5.04	4.02	2.93	126.30	86.76	279.22	82.85	**5**
29.21	11.66	293.46	38.19	1.96	50.31	6.44	4.78	3.38	133.00	94.91	311.35	93.39	**6**
28.77	11.03	293.02	38.37	2.01	49.63	6.04	4.60	3.27	132.22	94.20	311.00	86.00	**7**
29.43	11.12	283.94	40.78	1.95	48.13	6.37	4.54	3.21	134.44	95.65	301.74	90.11	**8**
29.25	11.50	304.56	40.67	2.16	50.70	6.19	4.71	3.33	132.99	94.12	322.41	90.24	**Mean**

Table (5): Phenotypic variance for studied traits in eight barley genotypes on eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/spike	No. of grains/spike	Spike length	Biology yield	Straw yield	MD	Heading date	No. of Tillers	Plant height	Traits / enotypes
3.74	85.91	22977.68	1164.50	3.37	78.20	8.44	13.61	6.67	279.90	439.38	24803.11	4825.88	**1**
5.88	78.80	11551.14	92.77	1.22	249.23	13.98	12.94	6.45	249.44	545.98	13087.66	2092.89	**2**
5.94	65.17	11900.44	267.73	1.22	194.27	8.57	10.61	5.27	272.27	923.59	13424.05	5779.36	**3**
1.05	76.18	26191.96	180.06	0.80	150.77	8.89	11.69	5.64	347.61	392.03	28143.88	1802.72	**4**
4.56	54.17	14775.56	124.06	0.60	69.66	17.53	9.56	4.90	606.42	821.96	16236.44	4010.49	**5**
6.91	124.11	18122.03	396.27	2.10	195.66	9.56	20.29	10.08	322.67	572.85	19809.66	3378.72	**6**
3.00	68.41	16330.33	29.53	0.64	123.98	7.31	10.72	5.22	484.22	866.25	17644.44	7426.22	**7**
3.14	85.12	16270.72	172.00	0.89	350.03	10.86	15.36	7.93	254.00	902.99	17540.79	4418.44	**8**
4.28	79.73	17264.98	303.36	1.36	176.48	10.64	13.10	6.52	352.07	683.13	18836.26	4216.84	**Mean**

Table (6): coefficient of variation for studied traits in eight barley genotypes on eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/spike	No. of grains/spike	Spike length	Biology yield	Straw yield	MD	Heading date	No. of Tillers	Plant height	Traits / Genotypes
6.62	76.09	46.54	79.88	79.04	16.80	50.29	73.77	72.95	12.64	22.50	45.86	77.78	**1**
8.13	73.86	36.82	23.50	51.75	30.71	66.41	74.44	74.91	11.96	24.85	36.94	49.73	**2**
8.32	74.97	34.79	39.50	48.88	26.56	45.68	73.91	73.70	12.49	32.40	34.95	88.61	**3**
3.29	61.67	43.34	26.23	27.80	30.21	38.33	62.50	62.92	13.19	19.71	42.87	41.43	**4**
7.85	80.75	46.49	35.11	53.70	13.83	83.12	76.92	75.64	19.50	33.05	45.63	76.44	**5**
9.00	95.55	45.87	52.13	73.77	27.80	47.97	94.23	93.90	13.51	25.22	45.21	62.24	**6**
6.02	75.00	43.61	14.16	39.79	22.44	44.78	71.24	69.78	16.64	31.24	42.71	100.20	**7**
6.02	83.00	44.92	32.16	48.49	38.87	51.74	86.24	87.68	11.85	31.42	43.89	73.77	**8**
6.91	77.61	42.80	37.83	52.90	25.90	53.54	76.66	76.44	13.97	27.55	42.26	71.27	**Mean**

Table (7): Regression coefficient for studied traits in eight barley genotypes on eighteen environments.

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/spike	No. of grains/spike	Spike length	Biology yield	Straw yield	MD	Heading date	No. of Tillers	Plant height	Traits / Genotypes
1.58	1.05	1.22	3.14	1.68	0.80	0.88	1.03	1.03	0.89	0.82	1.21	1.10	**1**
1.87	1.02	0.88	0.58	0.96	1.13	1.15	1.02	1.02	0.85	0.94	0.89	0.72	**2**
1.88	0.90	0.89	-0.11	0.65	1.04	0.89	0.90	0.90	0.89	1.17	0.90	1.20	**3**
0.55	0.99	0.99	1.18	0.92	1.12	0.89	0.96	0.94	1.01	0.71	1.00	0.66	**4**
1.18	0.82	0.99	1.10	0.79	0.68	1.38	0.84	0.85	1.33	1.07	0.99	1.00	**5**
-0.15	1.24	1.10	1.69	1.30	1.26	0.99	1.25	1.25	0.98	0.96	1.10	0.92	**6**
1.06	0.93	0.88	0.42	0.69	0.54	0.82	0.91	0.90	1.19	1.17	0.88	1.36	**7**
0.04	1.04	1.05	0.00	1.01	1.44	1.01	1.09	1.11	0.86	1.16	1.03	1.05	**8**
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	**Mean**

Table (8): Deviation of regression for studied traits in eight barley genotypes on eighteen environments

Harvest index	Grain yield	No. of spikes/m^3	1000-grain weight	Grains weight/spike	No. of grains/spike	Spike length	Biology yield	Straw yield	MD	Heading date	No. of Tillers	Plant height	Traits / Genotypes
-0.05	-0.11	-10.27	13.79	0.10	-1.24	-0.02	-0.02	-0.01	0.06	-1.09	-6.78	-2.69	**1**
0.02	-0.22	-63.18	2.72	0.03	4.92	0.04	-0.04	-0.02	-0.46	-1.97	-63.62	-0.84	**2**
0.02	-0.04	-65.66	15.57	0.05	2.77	-0.02	-0.01	-0.01	-0.69	2.91	-66.34	-1.77	**3**
-0.07	-0.16	663.80	2.04	0.01	-1.14	-0.01	-0.03	-0.02	-0.65	2.62	665.99	0.75	**4**
0.07	-0.03	-57.96	-0.46	0.01	-0.47	-0.04	0.00	0.00	-0.01	4.55	-58.50	-2.58	**5**
0.31	0.22	-62.28	7.06	0.06	-0.73	-0.06	0.02	0.01	-0.71	-1.90	-62.08	-0.91	**6**
-0.01	-0.06	240.02	-0.28	0.01	4.16	-0.04	-0.02	-0.01	-0.32	-1.35	242.37	2.75	**7**
0.08	-0.07	-63.89	9.66	0.01	5.48	0.01	-0.01	-0.01	-0.68	2.07	-63.62	-1.72	**8**
0.05	-0.06	72.57	6.26	0.03	1.72	-0.02	-0.01	-0.01	-0.43	0.73	73.43	-0.88	**Mean**

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