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YIELD STABILITY OF SOME BARLEY GENOTYPES

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ABSTRACT

To study the phenotypic stability of barley, sixteen different barley genotypes were grown under 9 different environments [three different levels of nitrogen (25, 40, and 55 kg N/faddan) X three successive seasons] in the Agricultural Research Station of Faculty of Agric., Cairo University, Giza, Egypt. A lattice square design with five replicates was used for each yield trial. The stability parameters: regression coefficients (b_i), mean squares due to deviations from regression (S^2_d), ecovalence (W_i), and the two non-parametric measure S^1 and S^3 were used. The Egyptian genotype (Giza 123) showed the highest mean grain yield (0.49 Kg m^{-2}) and the highest values of b_i for grain yield / m^2 (b_i= 2.02) and for number of grains / spike (b_i= 4.45). These results showed that the high yielding genotypes exhibited high response and more adaptability to good environmental conditions. Incontrast, the genotype No.8 exhibited the lowest yielding ability (0.36 Kg m^{-2}) among all studied genotypes. Highly significant positive correlation coefficients were detected between number of grains / spike and each of S^2_d, b_i, W_i, S^1 and S^3. Incontrast the correlation coefficients between the means of the other three studied traits (grain yield / m^2, seed index and spike length) and stability parameters were not significant. The observed correlation among stability parameters indicated that the ecovalence is highly significant associated with mean squares due to deviations from regression (S^2_d) and two non-parametric measures (S^1 and S^3). Highly significant correlation coefficient was detected between S^1 and S^3 for all studied traits. Our results showed that the production response index (b_i) and other stability statistics could be used in addition to mean yield by breeder in barley selection programmes when G x E is present.

Keyword: Phenotypic stability, parametric and non-parametric measures, correlation coefficients, Barley.

INTRODUCTION

Barley (*Hordeum vulgare* L.) is one of the most important cereal crops grown for malting in the brewing industry and it could be used for animals feeding. When it is grown under different environmental conditions, yield stability becomes one of the most important breeding objectives. Yield of barley varies greatly from year to year. One major cause of this variation in yield may be due to the behavior of genotypes grown and their interaction with the environment (G E). A statistical measure of these traits is very seldom considered in routine selection programs. In plant breeding programs, before selections, desirable genotypes are usually evaluated under different environments. Various techniques of phenotypic stability had been extensively studied by many investigators. Regression technique has been described by many workers (Finlay and Wilkinson, 1963 and Eberhart and Russell, 1966). Also, Eberhart and Russell (1966) added the deviation mean squares S^2_d which describe the contribution of genotype to G E interaction. With regard to repeatability of statistical measures, it is worthwhile to consider non parametric methods such as (S^1 and S^3) (Nasar and Hühn, 1987) which, theoretically, are less susceptible to outliers.

Knowledge of the extent of the genotype environment interaction as well as knowledge of the different stability parameters are necessary for characterization of yield stability. The response of barley to increase of N-application was studied by many workers (Abd El-Latif and Salamah, 1982 and Basha and El-bana, 1994). All barley yield attributes as well as straw and grain yield reflected significant increases due to N application up to 60 kg N feddan (Glelah, 1986). Increasing nitrogen levels up to 60 kg/ feddan caused progressive increase in number of spikes/ m^2, grain yield and straw yield (Towfelis, 1989). Zeiton *et al* (1986), reported that number of grains/ plant, number of spikes/ m^2 and grain yield/ feddan of barley increased significantly due to N- application up to 50 kg/ feddan. Correlation coefficients between the different stability parameters were studied by many investigators. Close association between the three stability parameters (W_i, r^2 and S^2_d) was detected by Langer *et al.* (1979) and Liovic and Kristek (2000). High correlation was detected between mean squares due to deviation from regression (S^2_d) and ecovalence (W_i) (Vertel *et al.* (1999) and Liovic and Kristek, 2000). Moderate correlation coefficients (r=0.37 to 0.55) was detected between mean grain yield and most of stability parameters (Duarte and Zimmermann, 1995 and Liovic and Kristek, 2000). Highly significant and positive correlation coefficients were detected between each of S^1, S^2 and S^3 measures (Huehn, 1990, Yue *et al*., 1997 and Scapim *et al*., 2000). The objectives of the present study were to assess: (1) the potential utility of some stability measures in evaluating yield stability of different barley genotypes and, (2) the association between different stability measures.

MATERIALS AND METHODS

To study the phenotypic stability of barley, sixteen different barley genotypes [13 of them belonged to two rowed German type and three were Egyptian genotypes i.e. Giza 123 (six rowed) and Giza 127, Giza 128 (two rowed types)] were sown in yield trials under three different levels of nitrogen (25, 40, and 55 kg N/faddan) over three successive seasons (2002/2003, 2003/2004 and 2004/2005) in the Agricultural Research Station of Faculty of Agric., Cairo University, Giza, Egypt. A lattice square design with five replicates was used for each yield trial.

In each season, nitrogen levels were devoted to the main plots, while the barley genotypes were allotted to the in sub-plots. Grains of barley were sown at the rate of 40 Kg/faddan, during December through the three successive seasons. Nitrogen fertilizer was applied in two equal doses i.e. (50%) were applied before the first irrigation (30 days from sowing) and the reminder (50%) before the second irrigation (60 days from sowing). The recommended cultural practices of growing barley were followed. Each plot consisted of nine rows 3 m long and the space between rows was 25 cm.

Data for grain yield/ m^2 were recorded for each plot during the three seasons. In addition, observations on spike length (cm), number of grains/ spike and seed index (thousand kernels weight in gm) were recorded.

Statistical analysis

Separate analyses of variance of individual experiments, as well as, a combined analysis were performed (Steel and Torrie, 1960). Phenotypic stability for different studied traits was assessed by the following methods:

Parametric measures

1. Regression techniques were used for the analysis of G E interaction to estimate S^2_d and b_i by the method of Eberhart and Russell, (1966).
2. Ecovalence parameter (W_i) which proposed by (Wricke, 1962) was used to calculate the ecovalence of each genotype as follows.

$$W_i = \sum \left(x_{ij} - \bar{x}_{i.} - \bar{x}_{.j} + \bar{x}_{..}\right)^2 \text{ , } where:$$

x_{ij} =the mean performance of a character on the i[th] variety in the j[th] environment, $\bar{x}_{i.}$ =mean of the variety over all environments, $\bar{x}_{.j}$ =mean of j[th] environment over all varieties, $\bar{x}_{..}$ =grand mean.

Non-parametric measures of stability

Non-parametric measures of phenotypic stability (S^1 and S^3), suggested by Huehn (1990) were computed by using the ranks based on corrected values (x_{ij}^*) as follows:

$$x_{ij}^* = x_{ij} - \left(\bar{x}_{i.} - \bar{x}_{..}\right)$$

$$S^1 = 2 \sum \left| r_{ij} - r'_{ij} \right| / N\ (N-1), \text{where}$$

S^1= mean of the absolute rank differences of genotypes over the environments.

$$S^3 = \sum \left| r_{ij} - \bar{r}_{i.} \right| / \bar{r}_{i.}, \text{where}$$

S^3= sum of absolute deviations of the r_{ij} 's from maximum stability expressed in $\bar{r}_{i.}$.

Moreover, simple correlation coefficients were calculated between all possible pairs of computed stability statistics.

RESULTS AND DISCUSSION

Highly significant differences were recorded among genotypes for grain yield (gm/ m^2), spike length (cm), seed index and number of grains/ spike (Table 1).

Mean squares due to genotypes x environment interaction mean significant in all cases (Table 1). The significant first order interaction indicated that there were changes in the relative rankings or magnitudes of the differences among genotypes over environments.

The significant interactions caused same difference in identifying superior yielding genotype. Therefore, several stability parameters, in addition to mean yields over environments were calculated.

Table (1): Analysis of variance for grain yield, spike length, seed index and No. of grains/spike for stability among 16 barley genotypes.

S.V	d.f	Mean square			
		grain yield	Spike length	Seed index	No. of grains/spike
Environments	8	127456.90**	1.46**	21.81**	11.50**
Genotypes	15	0.034**	2.40 **	34.85**	237.30**
Genotype x Environment	120	794.0**	35.63**	793.92**	341.85**
Env.+(Genotype x Env.)	128	0.167**	35.04**	853.60**	424.60**
Environment (Linear)	1	1.02**	11.68**	174.52**	92.00**
Genotype x Env. (Linear)	15	0.012*	0.28 *	4.39*	5.29**
Pooled deviation	112	0.006	0.13	2.44	1.93
Pooled Error	567	0.003	0.10	0.23	1.36

*** and ** significant or highly significant mean square at 0.05% and 0.01% probability levels respectively.**

Significance of F values for G x E linear revealed significant genetic differences among genotypes for their regression on environmental index. Moreover highly significant differences were recorded for pooled deviation for seed index indicating differences among different genotypes with respect to S^2_d (Table 1).

Eberhart and Russell, (1966) showed that, the ideal genotype is one which has highest yield over a broad range of environments, a regression coefficient (b_i) value of one and S^2_d of zero. Langer *et al*. (1979) showed that, the regression analysis explains the genotypes linear response to varying environments, and does not indicate the yield stability and the S^2_d is a true measure of production stability.

Significant F values were detected for genotypes x environment (linear) interaction for all studied traits, indicating that differences among the 16 barley genotypes regression coefficients were present (Table 1).

1-Grain yield (gm/m^2):

Data in (Table 2) revealed that total grain yield (gm/m^2) for the 16 genotypes ranged from 0.36 kg for genotype No.8 to 0.49 kg for Giza 123. Only two genotypes exhibited significant S^2_d values (genotypes No.4 and Giza 123) and it ranged between 0.0 for genotypes No.5 (more stable) to 0.01 for genotypes No.4 and Giza 123 (less stable). In respect to regression coefficient (b_i) of the barley genotypes it ranged between 0.34 for genotype No.11 to 2.02 for Giza 123. The large variation in the regression coefficients indicated that the different genotypes exhibited different environmental responses. Except genotypes No.1 and genotypes No.11, all genotypes exhibited significant regression coefficients. Giza 123 exhibited the highest responsiveness as compared to genotype No.11 which was adapted to poor environments.

In respect to ecovalence (W_i) it ranged between 0.12 for genotype No.3 and 1.62 for Giza 123 which was less stable. In respect to non parametric statistics (S^1 and S^3) genotype No.3 exhibited the lowest value in both S^1 and S^3. Incontrast, Giza 123 showed higher values for S^1 and S^3.

Form the above results, it could be concluded that Giza 123 exhibited the highest values for mean grain yield and it shows high values for most stability parameters.

Table (2): Mean of grain yield in kg/m^2 and S^2_d, b_i, W_i, S^1 and S^3 of 16 different barley genotypes.

grain yield in kg						
Genotypes	**Mean**	**S^2_d**	**b_i**	**W_i**	**S^1**	**S^3**
No.1	0.473	0.004	0.59	0.76	7.44	5.40
No.2	0.422	0.002	0.83**	0.42	3.72	2.79
No.3	0.471	0.005	1.03 *	0.12	2.61	1.94
No.4	0.460	0.014*	1.60 *	1.12	5.44	3.33
No.5	0.395	0.000	0.98**	0.22	5.11	4.33
No.6	0.452	0.013	1.09 *	2.05	5.17	7.50
No.7	0.487	0.002	0.72 *	0.46	4.94	4.29
No.8	0.355	0.001	0.89**	0.43	5.11	3.37
No.9	0.431	0.001	1.01**	0.18	4.06	3.39
No.10	0.411	0.000	0.52**	0.31	4.17	2.52
No.11	0.440	0.006	0.34	0.53	4.17	2.27
No.12	0.395	0.006	0.84 *	0.92	5.78	3.20
No.13	0.416	0.006	1.05 *	0.30	3.89	2.48
Giza 123	0.492	0.010*	2.02**	1.62	6.39	6.54
Giza 127	0.488	0.006	1.70 *	0.58	4.33	2.96
Giza 128	0.423	0.003	0.73	0.59	5.78	6.53

*** and ** significantly different from 1.0 for the regression coefficient and from 0.0 for the deviation mean squares at 0.05 and 0.01 levels of probability, respectively.**
S^2_d = Mean squares due to deviations from regression.
b_i = Regression coefficient.
W_i = Ecovalence.
S^1 and S^2 = Non-parametric measures.

2-Spike length (cm):

Data in (Table 3) revealed that mean spike length (cm) ranged from 7.28 cm to 9.25 cm for Giza 123 and genotype No.3, respectively. Mean squares due to deviations from regression (S^2_d) ranged between 0.0 for genotype No.2 and 0.33 for Giza 123. Only genotypes No.12, Giza 123 and Giza 127 exhibited significant S^2_d estimate which indicated, less stability for the above three genotypes (Table 3).

In respect to regression coefficients (b_i) for spike length (cm), it ranged between 0.13 for genotype No.11 to 2.28 for genotype No.6. Nine genotypes exhibited significant regression coefficients.

With regard to W_i for spike length, it ranged between 7.3 for genotype No.9 to 62.4 for genotype No.8 genotypes No.13 showed the lowest values for both S^1 and S^3, while genotypes No.8 exhibited the highest values, indicating that genotype No.8 showed a lowest level of stability as compared to genotype No.13.

From the above results, it could be concluded that, there were no clear trend for spike length (cm) with regard to stability parameters.

Table (3): Mean of spike length in cm and S^2_d, b_i, W_i, S^1 and S^3 of 16 different barley genotypes.

Spike length in cm						
Genotypes	Mean	S^2_d	b_i	W_i	S^1	S^3
No.1	8.47	0.09	1.28 *	13.67	4.44	3.41
No.2	9.18	0.00	1.13**	13.78	5.22	4.17
No.3	9.25	0.05	0.99**	27.47	5.39	3.68
No.4	8.04	0.16	1.07	50.87	5.89	3.93
No.5	8.38	0.12	0.76	21.10	5.39	3.86
No.6	8.88	0.05	2.28**	24.53	5.39	3.66
No.7	8.64	0.05	1.14**	22.83	6.28	3.85
No.8	9.09	0.10	1.39**	62.40	7.44	6.30
No.9	9.07	0.02	1.09**	7.30	4.11	2.89
No.10	8.84	0.06	0.98*	21.97	6.17	4.46
No.11	8.91	0.06	0.13	25.71	5.94	4.44
No.12	8.49	0.22 *	1.57**	42.14	5.89	4.03
No.13	8.88	0.05	0.65	10.72	4.00	2.92
Giza 123	7.28	0.33 *	0.70	50.37	7.33	5.90
Giza 127	8.30	0.28 *	0.22	46.86	6.39	5.11
Giza 128	8.12	0.03	0.43	14.64	5.33	4.35

*** and ** significantly different from 1.0 for the regression coefficient and from 0.0 for the deviation mean squares at 0.05 and 0.01 levels of probability, respectively.**
S^2_d = Mean squares due to deviations from regression.
b_i = Regression coefficient.
W_i = Ecovalence.
S^1 and S^2 = Non-parametric measures.

3-Seed index:

For mean seed index, it ranged between 38.11 gm and 46.39 gm for genotype No. 1 and Giza 123, respectively (Table 4). These was a wide range of S^2_d between 0.19 for genotype No.13 which exhibited a high degree of stability as compared to genotype No.4 (S^2_d = 6.7). Except for genotype No.9 and genotype No.13, the all remaining genotypes exhibited significant S^2_d values which were reflected on their stability behavior.

As regard to b_i for seed index, it ranged between (0.04 to 2.17). Eight genotypes exhibited significant b_i values. Genotype No.7 showed the highest degree of responsiveness in seed index for environmental conditions.

In respect to ecovalence coefficient (W_i) for seed index, it ranged between 40.61 for genotype No.13 which exhibited a high degree of stability to 1514.47 for genotype No.7 which was characterized by a low level of stability.

With regard to non-parametric stability measures for seed index, genotype No.13 showed the minimum values for both S^1 = 2.28 and S^3 = 1.54. Incontrast genotype No.7 showed the highest values for both S^1 7.8 and S^3 6.18.

From the above results, it could be concluded that genotype No.7 showed a low degree of stability for all statistical parameters (b_i, S^2_d, W_i, S^1 and S^3) for seed index. On the other hand, genotype No.13 exhibited a high degree of stability as compared to the other genotypes for this trait.

Table (4): Mean of 1000-grain weight (seed index) in gm and S^2_d, b_i, W_i, S^1 and S^3 of 16 different barley genotypes.

Seed index						
Genotypes	**Mean**	**S^2_d**	**b_i**	**W_i**	**S^1**	**S^3**
No.1	38.11	1.04 *	0.70	213.78	4.83	3.52
No.2	40.16	1.02 *	0.66	218.64	4.67	3.86
No.3	41.70	0.77 *	2.13**	492.68	6.44	4.76
No.4	40.48	6.71 *	0.87	1187.89	7.50	6.13
No.5	40.03	1.20 *	-0.04	518.15	6.17	4.45
No.6	39.39	0.96 *	0.39	278.35	5.67	4.32
No.7	41.08	6.44 *	2.17 *	1514.47	7.83	6.18
No.8	39.89	1.19 *	1.02**	216.97	4.28	3.00
No.9	40.64	0.35	0.99**	69.07	3.11	2.16
No.10	38.67	0.65 *	1.59**	219.52	4.89	3.68
No.11	38.95	1.99 *	1.12 *	359.33	5.06	3.38
No.12	40.82	4.04 *	1.27 *	593.73	6.00	4.39
No.13	39.39	0.19	0.97**	40.61	2.28	1.54
Giza 123	46.32	2.53 *	0.13	660.00	6.83	5.00
Giza 127	42.99	4.11 *	0.32	856.47	7.11	5.84
Giza 128	41.86	5.16 *	1.46	970.21	6.44	4.96

*** and ** significantly different from 1.0 for the regression coefficient and from 0.0 for the deviation mean squares at 0.05 and 0.01 levels of probability, respectively.**
S^2_d = Mean squares due to deviations from regression.
b_i = Regression coefficient.
W_i = Ecovalence.
S^1 and S^2 = Non-parametric measures.

4-Number of grains/ spike:

With respect to mean number of grains/ spike, it ranged between 23.56 for genotype No.8 and 45.61 for Giza 123 (Table 5). Data in (Table 5) showed a wide range of variability of b_i, it ranged between 0.27 for genotype No.1 and 4.45 for Giza 123. These results indicated that high degree of responsiveness is existed for Giza 123 which gave it more adaptability for the nine environments.

Only one genotype (Giza 123) showed significant and the highest S^2_d value for grains/ spike. With regard to b_i for this trait, only seven genotypes exhibited significant regression coefficients. Some genotypes exhibited a high degree of stability (b ≈ 1) (genotypes No. 6, 10, 13 and Giza 127). Ecovalence values for this trait ranged between 49.42 for genotype No.2 and 3467.9 for Giza 123. In respect to S^1 and S^3, genotype No.2 exhibited the lowest values for number of grains/spike.

On the other hand, Giza 123 showed the highest values of both S^1 and S^3 for this trait. From the above mentioned results, it could be concluded that genotype No.2 exhibited the minimum values for most stability parameters. Incontrast, Giza 123 showed the highest values for all stability parameters.

Form the above mentioned results, it could be concluded, that there is a harmony between total grain yield and number of grains/ spike, where as the lowest genotype in mean number of grains/ spike showed the lowest grain yield, while the genotype which showed the highest mean number of grains/spike exhibited the highest grain yield. So, this indicated to the importance of number of grains/ spike trait as a selection criterion.

Table (5): Mean of number of grains/ spike and S^2_d, b_i, W_i, S^1 and S^3 of 16 different barley genotypes.

Number of grains/ spike						
Genotypes	**Mean**	**S^2_d**	**b_i**	**W_i**	**S^1**	**S^3**
No.1	26.70	-5.59	0.27	320.54	5.78	4.82
No.2	25.24	-6.52	0.69**	49.42	3.56	2.76
No.3	26.20	-5.98	0.49	114.67	4.22	3.27
No.4	24.35	-5.83	0.32	343.61	5.83	4.30
No.5	25.16	-5.58	0.77	284.08	5.83	4.31
No.6	25.42	-5.50	0.97	237.16	4.50	2.89
No.7	24.19	-6.31	0.73	145.30	5.06	3.75
No.8	23.56	-6.25	0.89 *	126.64	5.06	3.74
No.9	25.50	-5.57	0.48	211.38	5.78	4.22
No.10	25.23	-6.40	1.07**	408.32	6.00	4.44
No.11	25.79	-6.06	0.66	147.48	4.06	2.77
No.12	26.08	-4.64	1.20	441.99	6.72	5.38
No.13	25.84	-6.12	1.00 *	159.06	4.94	3.28
Giza 123	45.61	9.04 *	4.45 *	3467.89	8.33	7.11
Giza 127	25.24	-6.02	1.09 *	300.18	6.11	4.46
Giza 128	25.15	-4.51	0.92	328.47	6.78	5.05

*** and ** significantly different from 1.0 for the regression coefficient and from 0.0 for the deviation mean squares at 0.05 and 0.01 levels of probability, respectively.**
S^2_d = Mean squares due to deviations from regression.
b_i = Regression coefficient.
W_i = Ecovalence.
S^1 and S^2 = Non-parametric measures.

Simple correlation coefficients:

Except number of grains/spike, pairs of correlation coefficients between the mean performance of the studied traits and stability parameters ranged from low to high (Table 6). The correlation coefficients between mean number of grains/ spike and different stability parameters were positive and highly significant. Incontrast, the correlation coefficients between means of the other three traits (grain yield (gm/m^2), seed index and spike length (cm)) and stability parameters were not significant.

Apparently, a weak relationship was exhibited between the mean performances of studied traits and their response to environmental variations. In most cases, S^2_d tended to be dependent of other stability statistics. It showed high correlation with most of the other stability parameters (Table 6).

Table (6): Simple correlation coefficients between the stability parameters (Index I vs. Index II) for four studied traits.

Index I	Index II	grain yield	Spike length	Seed index	No. of grains/ spike
$\bar{x}$	S^2_d	0.46	-0.75**	0.34	0.98**
$\bar{x}$	b_i	0.42	0.27	-0.17	.094**
$\bar{x}$	W_i	0.33	-0.38	0.43	0.98**
$\bar{x}$	S^1	0.11	-0.37	0.50	0.62 *
$\bar{x}$	S^3	0.24	-0.35	0.48	0.70**
S^2_d	b_i	0.54 *	-0.20	0.22	0.95**
S^2_d	W_i	0.80**	0.72**	0.94**	0.99**
S^2_d	S^1	0.22	0.57 *	0.76**	0.70**
S^2_d	S^3	0.33	0.54 *	0.79**	0.76**
b_i	W_i	0.45	0.05	0.27	0.96**
b_i	S^1	0.12	-0.06	0.08	0.66**
b_i	S^3	0.23	-0.18	0.07	0.70**
W_i	S^1	0.45 *	0.83**	0.87**	0.71**
W_i	S^3	0.72**	0.77**	0.89**	0.77**
S^1	S^3	0.69**	0.91**	0.99**	0.97**

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

In respect to regression coefficient (b_i), except for number of grains/ spike, the results in Table (6) showed that b_i tended to be independent of the other stability statistics. These results were in harmony with those obtained by Nguyen *et al*. (1980).

Highly significant correlation coefficients were detected between W_i and each of S^1 and S^3 for all studied traits, which indicates that any of them could be a satisfactory parameters for measuring stability. These results are in harmony with those obtained by Shrief (2003).

Also, highly significant correlation coefficients were detected between S^1 and S^3 for all the studied traits.

Our results demonstrated that the production response index (regression coefficient) and other stability statistics could be used in addition to mean grain yield by barley breeders in the selection process when G x E interactions is present.

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ثبات المحصول في بعض التراكيب الوراثية بالشعير

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تم تقييم أداء ١٦ تركيب وراثي من محصول الشعير [١٣ تركيب وراثي من اصل ألماني (ثنائية الصفوف) و ٣ تراكيب وراثية مصرية وهى جيزة ١٢٣ (سداسي الصفوف) ، جيزة ١٢٧ و جيزة ١٢٨ (ثنائي الصفوف)] وذلك في ٩ بيئات مختلفة.

وقد اجري تحليل الثبات للصفات التي أظهرت تجانسا بالنسبة للأخطاء التجريبية وكذلك أظهرت تفاعل معنوي بين التراكيب الو راثية والبيئات باستخدام بعض مقاييس الثبات وهى متوسط مربعات الانحرافات عن خط الانحدار (S^2_d) ، معامل الانحدار (b_i) ، معامل المكافئ البيئي(W_i) و بعض المقاييس اللامعلمية(مثل S^3 , S^1) وذلك لتقدير كفاءة هذه المقاييس في تقدير درجة الثبات وكذلك تقدير مدى قوة التلازم بين هذه المقاييس المختلفة.

وقد أظهرت النتائج أن صنف الشعير المصري جيزة ١٢٣ تفوق في متوسط محصول المتر المربع (٠,٤٩ كجم) واظهر اكبر قيم لمعامل الانحدار b_i بالنسبة لصفة محصول الحبوب / المتر المربع، عدد الحبوب / السنبلة و وزن الألف حبة بالمقارنة بالتركيب الوراثى رقم (٨)الذى اظهر اقل قدرة محصولية (٠,٣٦ كجم) .

أظهرت نتائج الارتباط بين مقاييس الثبات أن المكافئ البيئي(W_i) كان الأكثر ارتباطا مع كل من مربعات الانحرافات عن خط الانحدار (S^2_d) ، معامل الانحدار (b_i) و المقاييس اللامعلمية (S^3 , S^1)، كما أظهرت النتائج ارتباطا عالي المعنوية بين المقاييس اللامعلمية (S^3 , S^1) لكل الصفات المدروسة.

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