Egypt. J. Plant Breed. 12(2): 1-13(2008)

GENOTYPE X ENVIRONMENT INTERACTION AND STABILITY ANALYSIS FOR SEED COTTON YIELD OF ELEVEN EGYPTIAN COTTON GENOTYPES

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ABSTRACT

The present study was conducted at in the two seasons of 2005 and 2006. The breeding materials used were eight commercial varieties, viz. Giza 45, Giza 70, Giza 80, Giza 83, Giza 86, Giza 88, Giza 89 and Giza 90 along with three promising lines derived from the cross Giza 45 × Giza 83. Thirteen stability measures, viz. mean, regression coefficient, mean squares of deviation from regression, environmental variance, coefficient of variation, coefficient of determination, ecovalence stability index, stability variance, yield stability, superiority index and non-parametric statistics ($S_i^{(1)}$, $S_i^{(2)}$, $S_i^{(3)}$) calculated on seed cotton yield of 11 Egyptian cotton genotypes evaluated across 18 variable environmental conditions (combinations of two seasons, three sowing dates and three plant densities) were used to assess performance, stability and adaptability of the genotypes and to study interrelationships among these measures. The data confirmed the existence of considerable variation among cotton genotypes and their performance was significantly influenced by the changes in seasons, sowing dates and plant densities as well as the interactions between them. Results of stability analysis demonstrated that mean squares due to genotypes (G) were significant, indicating substantial variability existed among genotypes for seed-cotton yield. Highly significant mean squares due to environments (E) and (G x E) interaction indicated that such genotypes interacted considerably with environmental conditions for seed cotton yield. Both linear and non-linear components of G x E interaction were important in the expression of this trait, but the non-linear component was larger in magnitude. It is worthy to note that different stability parameters were different in identifying the stable genotypes. Stability parameters however, considered Giza 90 and line 1 as stable genotypes. These two genotypes proved to be superior in both mean yield and stability as well as widely adaptability to such environmental conditions. Correlations between stability parameters suggested that mean performance can be used to some extent as a simplified measurement to judge the response and stability of cotton genotypes for seed cotton yield when grown under different environments.

Key words. ***Cotton, G x E interaction, Stability parameters, Non-parametric statistics, Correlation***

INTRODUCTION

Genotype x environment (GE) interactions result in genotype rank changes from one environment to another, a difference in scale among environments, or a combination of these two situations. If relative performances of genotypes gown in different environments are different, then GE interaction becomes a major challenging factor to crop breeding programs (Zobel and Talbert 1984). In such cases, the breeder is faced either with developing specific breeding populations for each environment and/or with selecting genotypes that generally perform well across a range of environments. Some genotypes are adapted to a broad range of environmental conditions, while others have specific adaptation to a restricted set of environments. Some genotypes have similar performance regardless of the productivity level of the environment, and others have their performance directly related to the productivity potential of the environment, indicating the importance of stability analysis in defining the adaptation of genotypes.

Genotype x environment interaction complicates the identification of superior genotypes (Allard and Bradshaw 1964), but its interpretation can be facilitated by the use of several statistical methods. These methods can be linear formulations such as joint regression (Yates and Cochran 1938 and Eberhart and Russell 1966), multivariate clustering techniques (Lin and Butler 1990), multiplicative such as additive mean effects and multiplication interaction or non-parametric methods (Huehn 1979). Modeling GE interaction in multi-environment trials helps to determine phenotypic stability of genotypes, but this concept has been defined in different ways and increasing numbers of stability parameters have been developed (Gauch and Zobel 1996). Huehn (1996) emphasized two major approaches for studying GE interaction to determine the adaptation of genotypes. The first and most commonly used approach is parametric, which relies on distributional assumptions about genotypic, environmental and GE interaction effects. The second is the non-parametric approach, which does not need any assumptions. Although several models for the statistical measurement of stability have been proposed, no single method adequately explains genotype performance across environments. For practical applications, however, most breeding programs are now incorporating some elements of both parametric and non-parametric approaches (Becker and Léon 1988).

Several parametric methods including univariate and multivariate ones have been developed to assess the stability and adaptability of genotypes. The most widely used is the joint regression including regression coefficient (b_i) and variance of deviations from regression (S^2_{di}) (Eberhart and Russell 1966). Some other univariate stability parameters are the environmental variance (S^2_i) (Lin *et al* 1986, Becker and Léon 1988), Shukla's (1972) stability variance, Wricke's ecovalence (W^2_i) (Wricke 1962) and the coefficient of variability (CVi) (Francis and Kannenberg 1978).

Non-parametric procedures proposed by Huehn (1979) and Nassar and Huehn (1987) are based on the ranks of genotypes in each environment, and the genotypes with similar ranking across environments are classified as stable. Non-parametric methods have some advantages over parametric stability methods. They reduce the bias caused by outliers and no assumptions are needed about the distribution of observed values. They are easy to use and interpret, and additions or deletions of one or a few genotypes have little effect on the results (Huehn 1990).

Therefore, the objectives of this study were to (1) evaluate the adaptation and stability of eleven Egyptian cotton genotypes under 18 different environments and (2) study the relationships among the parameters of stability methods.

MATERIALS AND METHODS

Eight Egyptian cotton varieties belonging to *Gossypium barbadense,* L. namely; Giza 45, Giza 70, Giza 80, Giza 83, Giza 86, Giza 88, Giza 89 and Giza 90 along with three promising lines (line 1, 2 and 3) derived from the cross (Giza 45 × Giza 83) were evaluated at the Agric. Exp. Stat. of Ain Shams Univ., Shalakan, Kalubia Governorate, Egypt., during the two successive seasons of 2005 and 2006. The tested genotypes were planted at three planting dates. At each planting date a split-plot design with three replicates was carried out where the main plots were devoted for three hill spacings (20, 25, and 30 cm), and sub-plots were assigned for the eleven genotypes. Planting dates were; 22nd March, 7th April and 23rd April in the first season and 22nd March, 8th April and 25th April in second season. The experimental plot consisted of a single ridge, 3.5 m long and 70 cm width. Hills were thinned to two plants per hill and all other traditional cultural practices for cotton production were followed during the growing seasons. Measurements were recorded on ten individual guarded plants chosen at random from each plot for the seed cotton yield per plant (g).

Homogenety test for two seasons data were carried out and consequently the combinations of the two growing seasons, the three sowing dates and the three plant densities were considered as 18 different environments. Combined analysis of variance was performed according to Gomez and Gomez (1984). The following stability statistics for genotypes under study were estimated:

1. The linear regression coefficient (b_i) and mean square of deviation from regression for each genotype (S^2_d) of the model described by Eberhart and Russell (1966).
2. The ecovalence stability index (W^2_i) developed by Wricke (1962).
3. The coefficient of determination (r^2_i) between average yield of each genotype and environmental index as outlined by Pinthus (1973).
4. The stability variance (σ^2_i) as outlined by Shukla (1972).
5. Yield-stability statistic (Ys_i) developed by Kang (1993) calculated by STABLE computer program after Kang and Magari (1995).
6. The superiority index (P_i) according to Lin and Binns (1988).

7. The coefficient of variation (CV_i) of each genotype according to Francis and Kannenberg (1978).

8. The variance of genotype across environments (S^2_i).

9. The nonparametric statistics $S_i^{(1)}$, $S_i^{(2)}$, and $S_i^{(3)}$ proposed by Huehn (1979).

In addition, the correlation coefficients were computed between all pairs of stability parameters obtained by different biometrical methods.

RESULTS AND DISCUSSION

Analysis of variance and mean performance:

The combined analysis of variance for seed cotton yield/plant of eleven cotton genotypes evaluated under eighteen different environmental conditions is presented in Table (1). Genotypes (G) mean squares were highly significant for seed cotton yield/plant, revealing that the genotypes under study differ in their genetic potential for this trait and variability exists among the tested genotypes. The mean squares due to years (Y) were significant for this trait. Such results reflect the seasonal effects. Meanwhile, the mean squares due to both sowing dates (S) and plant densities (D) were significant for this trait. In addition, the first order interactions of (G x Y) and (G x S) were highly significant for seed cotton yield/plant, whereas G x D were not significant for the studied character. These results indicated the importance of such agricultural treatments on the performance of studied cotton genotypes for seed cotton yield. Moreover, the other high orders of interaction, *viz.* G x S x Y and G x D x Y were significant, while G x Y x S x D were not significant for this character.

The mean performance for seed cotton yield/plant of eleven Egyptian cotton genotypes over all 18 different environments is presented in Table (2). As shown in Table (2), the individual environments ranged from 11.75 g in E_7 (3rd sowing date with hill spacing 20 cm in the first season) to 42.35 g in E_{12} (1st sowing date with hill spacing 30 cm in the second season) for this trait. Moreover, the environments E_1, E_2, E_3, E_4, E_{10}, E_{11} and E_{12} produced higher mean performance for seed cotton yield/plant than the grand mean of all the studied environments. These environments could be considered as non-stress environments for such Egyptian cotton genotypes. The mean values ranged from 21.70 g for the genotype Giza 70 to 32.29 g for Giza 83 with an average of 25.99 g for seed cotton yield/plant.

Table 1. Combined analysis of variance for seed cotton yield of eleven cotton genotypes over two seasons, three plant densities and three planting dates.

Source of variance	d.f.	Mean squares
Years (Y)	1	304.80**
Sowing date (S)	2	24417.03**
Density (D)	2	2757.13**
SY	2	64.81**
DY	2	6.14
SD	4	162.95**
SDY	4	6.48
Error (a)	32	11.14
Genotypes (G)	10	642.38**
GY	10	28.94**
GS	20	70.04**
GD	20	6.84
GSY	20	18.61**
GDY	20	6.40*
GSD	40	5.46
GSDY	40	4.44
Error (b)	360	3.85

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

Analysis of phenotypic stability

Results of stability analysis of variance presented in Table (3) revealed that the genotypes mean squares were highly significant, indicating the presence of genetic variability among entries in this character. The mean squares due to environments (E) were also significant, revealing a wide range of environmental effects.

However, significant mean squares due to environments and G x E interactions were detected, suggesting that genotypes interacted considerably with environments for this trait. The linear component of G x E interaction was significant and predictable for seed cotton yield/plant. On the other hand, the non-linear portion of interactions due to the deviation from regression was significant for this character, suggesting that relatively unpredictable component of the G x E interaction was of importance in determining the degrees of stability for studied cotton genotypes. In this respect, Eberhart and Russell (1969) mentioned that the most important stability parameter appeared to be the deviation from regression mean squares, where all types of gene action are to be involved in this parameter and considered genotypes with the lowest deviation being the most stable. Also, Becker *et al* (1982) stated that the mean squares for deviation from regression could be considered the most appropriate criterion for measuring phenotypic stability in an agronomic sense, because this parameter gives

Table 2. Mean performance of genotypes, environments (seasons, plant densities and sowing dates) and their interactions for seed cotton yield.

season	2005									2006									Average
Sowing	March 22			April 7			April 23			March 22			April 8			April 25			
Density	20 cm	25 cm	30 cm	20 cm	25 cm	30 cm	20 cm	25 cm	30 cm	20 cm	25 cm	30 cm	20 cm	25 cm	30 cm	20 cm	25 cm	30 cm	
Env.	E_1	E_2	E_3	E_4	E_5	E_6	E_7	E_8	E_9	E_{10}	E_{11}	E_{12}	E_{13}	E_{14}	E_{15}	E_{16}	E_{17}	E_{18}	
Giza 45	25.29	30.73	33.28	21.97	24.78	26.68	9.84	11.14	14.26	28.85	34.42	37.89	23.73	25.09	29.73	11.03	13.58	15.25	23.20
Giza 70	23.33	24.25	30.07	19.08	23.08	26.63	12.06	13.48	15.82	27.72	31.35	34.89	21.33	٢٣,٩٥	27.41	9.49	12.20	14.52	21.70
Giza 80	26.54	28.76	32.30	19.71	23.67	27.41	11.06	13.20	14.80	29.31	35.98	41.32	23.48	٢٨,٤٣	30.38	11.32	13.14	16.57	23.74
Giza 83	38.05	47.61	54.00	31.17	34.32	39.89	14.72	16.67	18.38	40.61	42.56	50.26	30.71	٣٣,٢٣	37.92	13.94	17.45	19.70	32.29
Giza 86	27.52	33.45	35.51	19.05	26.01	30.06	12.10	12.88	13.77	31.36	36.00	41.18	23.72	27.02	33.82	9.98	12.08	14.46	24.44
Giza 88	24.93	30.90	36.76	21.50	23.86	31.89	9.72	11.04	12.80	25.02	33.83	38.21	19.81	25.08	29.58	9.85	13.79	14.96	22.97
Giza 89	28.87	33.46	35.08	22.32	26.49	27.96	9.53	11.89	13.87	29.05	34.70	43.22	26.48	31.83	33.67	12.05	13.16	13.79	24.86
Giza 90	37.92	42.60	48.64	27.22	36.37	37.60	15.37	17.89	17.28	37.86	44.62	51.89	27.77	30.43	36.59	17.35	19.91	22.27	31.64
Line 1	30.19	32.79	38.33	26.14	35.64	38.02	14.00	14.92	15.98	31.35	36.54	42.44	23.80	30.75	34.14	12.69	15.32	17.48	27.25
Line 2	32.12	35.25	40.09	24.41	28.01	32.79	10.91	13.05	13.37	35.67	37.91	41.90	26.44	30.84	35.79	12.42	14.38	15.96	26.74
Line 3	30.00	38.63	44.15	23.71	32.17	35.61	9.98	14.17	15.62	33.78	37.92	42.65	26.09	30.24	33.10	10.75	12.75	15.81	27.06
Average	29.52	34.40	38.93	23.30	28.58	32.23	11.75	13.67	15.09	31.87	36.89	42.35	24.85	28.81	32.92	11.90	14.34	16.43	25.99
L. S. D. at 5% level for	Environments (E) = 0.95 , Genotypes (G) = 0.74 and G x E = 3.15																		

Table 3. Stability analysis of variance of seed-cotton yield for eleven Egyptian cotton genotypes over 18 different environments.

Source of variation	d.f.	Mean squares
Genotypes (G)	10	642.38**
Environments (Env.) + (G x Env.)	187	311.21**
Env. (linear)	1	55472.75**
G x Env. (linear)	10	110.92**
Pooled deviation	176	9.17**
Pooled error	360	3.854

** denote significant at 0.01 levels of probability.

the predictability of genotypic reaction to environmental conditions. These findings are more or less in agreement with the previous results of Abo El-Zahab *et al* (1992 and 2003), El-Harony *et al* (2000), El-Feki *et al* (2002), Ashmawy *et al* (2003), Abdalla *et al* (2005) and Mohamed *et al* (2005).

Estimates of stability parameters for seed cotton yield

The results of the stability measures regarding seed cotton yield are given in Table (4). It is clear that the studied genotypes showed significant differences in this trait. Considering mean yield as a first parameter for evaluating the genotypes, Giza 83 and Giza 90 gave the best mean yields, while Giza 70, Giza 88 and Giza 45 had the lowest mean yields across environments. Genotypes Giza 83, Giza 90, Line 2 and Line 3 with regression coefficients (b_i) higher than one had the highest yield performance and were adapted to favorable environments, while Giza 45, Giza 70, Giza 80 and Giza 88 with bi <1 and the lowest average yields were poorly adapted across environments and might have a specific adaptation to poor conditions.

Giza 83 with the high mean yield had the maximum variance in regression deviation (S^2d_i), while line 2 with the low S^2d_i value ranked the fifth for yield performance. This genotype had a good combination for yield and stability.

According to the environmental variance (S^2_i), Giza 70 followed by Giza 45 and Giza 80 had the lowest variance across environments and Giza 83 followed by line 3, Giza 90 and line 2 showed the largest variation.

The W^2_i was lowest for genotypes, Giza 86, line 2 and Giza 45 and highest for genotypes, Giza 83, Giza 70 and Giza 90.

As for Francis and Kannenberg's (1978), stability parameter (CV_i), the genotypes, Giza 70, Giza 45 and Giza 80 were considered to be stable although they had low performance, and the genotypes, line 3, Giza 83 and Giza 89 with the high yield performance were considered unstable.

According to Lin and Binns (1988), the superior genotype should be the one with the lowest P_i value. In such cases, the genotypes of greatest

Table 4. Estimates of stability parameters for seed cotton yield per plant of eleven Egyptian cotton genotypes over 18 environments.

Stability methods	Eberhart & Russell 1966			Wricke 1962	Pinthus 1973	Shukla 1972	Lin & Binns 1988	Francis & Kannenberg 1978	Variance of environments	Huehn 1990			Kang 1993
Genotypes	**Mean**	b_i	S^2d	W^2_i	r^2	σ_i^2	P_i	CV_i	S^2_i	$S_i^{(1)}$	$S_i^{(2)}$	$S_i^{(3)}$	Ysi
Giza 45	23.20	0.876**	-0.182	131.014	0.987	2.546**	58.709	37.794	76.840	2.771	5.791	6.440	3+
Giza 70	21.70	0.734**	0.849	459.039	0.964	10.407**	82.443	34.267	55.290	3.902	11.559	7.302	5+
Giza 80	23.74	0.883**	1.876**	220.588	0.965	4.691**	56.151	37.697	80.100	2.601	5.163	4.677	-1+
Giza 83	32.29	1.267**	4.780**	651.059	0.966	16.016**	1.035	39.724	164.48	3.294	9.007	5.243	-5
Giza 86	24.44	0.996	0.321	77.112	0.985	1.254	44.891	40.846	99.690	3.346	9.085	9.400	-10
Giza 88	22.97	0.930*	1.126*	140.083	0.978	2.766**	58.914	40.803	87.860	2.987	6.801	7.221	-7
Giza 89	24.86	1.000	2.487**	181.050	0.966	3.749**	42.824	40.713	102.41	3.974	11.656	9.347	5+
Giza 90	31.64	1.146**	2.960**	310.586	0.973	6.850**	2.623	36.548	133.76	4.085	13.088	7.581	4+
Line 1	27.26	0.969	3.807**	249.250	0.962	5.381**	26.288	36.257	97.620	3.915	11.781	10.124	2+
Line 2	26.74	1.069*	0.464	107.091	0.989	1.973	26.223	40.026	114.53	3.412	8.468	8.261	-8
Line 3	27.06	1.130**	1.023*	196.495	0.985	4.114**	20.871	41.890	126.62	3.471	8.840	8.238	-9
Mean	25.99												
L.S.D $_{0.05}$	2.31												

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

b_i: the linear regression coefficient, S^2d: the mean squares of deviation from regression, W^2_i: the contribution of each genotype to the genotype × environment interaction, r^2_i: the coefficient of determination, σ^2_i: stability variance according to Shukla (1972), Ys_i: yield stability, P_i: superiority index, CV_i: the coefficient of variability, S^2_i : variance of environments and $S_i^{(1)}$, $S_i^{(2)}$, and $S_i^{(3)}$: the nonparametric statistics.

interest would be those with the lowest P_i values, most of which would be attributed to genetic deviation. consequently, the genotypes Giza 83, Giza 90 and line 3 have the greatest mean yield and the lowest P_i values, indicating their stability in this respect.

The coefficients of determination (r^2_i) showed high values for genotypes, Giza 45, Giza 86, line 2 and line 3 exhibiting their stability for this trait in those tested genotypes. These results were obtained by El-Harony *et al* (2000).

Concerning stability-variance of Shukla (1972), the results revealed that Giza 86 and line 2 showed insignificant values of (σ^2_i), indicating their stability for this trait. These results were reported by Abdalla *et al* (2005).

Simultaneous yield stability statistic developed by Kang (1993) characterized Giza 90, line 1 and Giza 89 as superior and stable genotypes.

The $S^{(1)}_i$ and $S^{(2)}_i$ statistics are based on ranks of genotypes across environments and they give equal weight to each environment. Genotypes with fewer changes in ranking are considered to be more stable (Becker and Léon 1988). Accordingly, Giza 80, Giza 45 and Giza 88 had the smallest changes in rank and thus, they are regarded as the most stable genotypes. The other non-parametric statistic $S^{(3)}_i$ combining yield and stability based on yield ranks of genotypes in each environment were proposed by Huehn (1979). This parameter measures stability in units of the mean rank of each genotype. According to $S^{(3)}_i$, Giza 80 followed by Giza 83 were considered as the most stable genotypes.

Interrelationships between stability statistics

The simple correlation coefficients calculated among stability parameters, viz b_i, S^2d, W^2_i, r^2_i, σ^2_i, Ys_i, P_i, CV_i, S^2_i, $S_i^{(1)}$, $S_i^{(2)}$, $S_i^{(3)}$ and mean are presented in Table (5). The results showed that mean yield was significantly and positively associated with each of b_i and environmental variance (S^2_i), indicating increase in mean performance of genotypes for seed cotton yield in favorable growing environments. Moreover, the correlation between mean yield and S^2_d was positive and significant, suggesting that genotypes characterized by high seed cotton yield tended to show high non-linear response to environments and thus show low stability for this trait.

The b_i value was significantly and positively correlated with S^2_i. Although they refer to different types of stability, the positive correlation between the variance of genotypes and regression coefficient would be expected as genotypes with steep regression show a large variability across environments (Weber and Wricke 1987).

Furthermore, the association between b_i and S^2_d was found to be insignificant, suggesting independence of these two stability parameters and governed by different genetic systems for this trait. Meanwhile, significant

Table 5. Correlation coefficients among 13 stability parameters for seed cotton yield per plant over [illegible] environments.

	Mean	b_i	S^2d	W^2_i	r^2	σ^2_i	Ys_i	P_i	CV_i	S^2_i	$S_i^{(1)}$	$S_i^{(2)}$
b_i	0.904**											
S^2d	0.721*	0.538										
W^2_i	0.488	0.276	0.675*									
r^2	0.168	0.376	-0.278	-0.404								
σ^2_i	0.454	0.292	0.632*	0.871**	-0.587							
Ys_i	-0.090	-0.404	0.246	0.261	-0.597	0.261						
P_i	-0.963**	-0.950**	-0.620*	-0.270	-0.299	-0.272	0.234					
CV_i	-0.276	0.098	-0.324	-0.173	0.200	-0.188	-0.736**	0.164				
S^2_i	0.925**	0.994**	0.593	0.377	0.318	0.378	-0.362	-0.945**	0.077			
$S_i^{(1)}$	0.347	0.178	0.369	0.247	-0.644*	0.370	0.397	-0.307	-0.187	0.198		
$S_i^{(2)}$	0.406	0.201	0.442	0.320	-0.651*	0.428	0.425	-0.339	-0.272	0.229	0.988**	
$S_i^{(3)}$	-0.053	0.001	-0.082	-0.446	-0.376	-0.149	-0.024	-0.089	0.059	-0.048	0.647*	0.588

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

b_i: the linear regression coefficient, **S^2d**: the mean squares of deviation from regression, **W_i**: the contribution of each genotype to the genotype × environment interaction, **r^2_i**: the coefficient of determination, σ^2_i: stability variance according to Shukla (1972), **Ys_i**: yield stability, **P_i**: superiority index, **CV_i**: the coefficient of variability, S^2_i : variance of environments and $S_i^{(1)}$, $S_i^{(2)}$, and $S_i^{(3)}$: the nonparametric statistics.

negative correlation was found between superiority index (P_i) and each of mean, b_i, S^2_d and S^2_i. The ecovalence stability index (W^2i) showed positive and significant correlation with σ^2_i, revealing that the relative rankings of genotypes for these parameters were the same. Also, r^2_i with $S_i^{(1)}$ and $S_i^{(2)}$

exerted negative and significant correlation. The nonparametric statistic $S_i^{(1)}$ had positive and significant correlation with the $S_i^{(2)}$ and $S_i^{(3)}$. These results are in agreement with those obtained by El-Harony *et al* (2000).

In conclusion, the results of comparative stability parameters indicated that Giza 86, Giza 90 and line 1 could be considered the most stable genotypes. The stability statistics used in the present study may lead to more simplified description of the G x E interaction and provide useful information to cotton breeders for selection of superior and stable genotypes. The present findings of correlations suggested that yield mean performance can be used to some extent as a simplified measurement to judge the response and stability of cotton genotypes for seed cotton yield when grown under different environments.

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التفاعل بين البيئة والتركيب الوراثي وتحليل الثبات لمحصول القطن الزهر لأحد عشر تركيباً وراثياً من القطن المصري

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يهدف هذا البحث إلى تقييم معايير الثبات المختلفة ومقارنة كفاءة هذه المعايير وذلك لاختيار أفضلها من حيث الكفاءة وسهولة القياس لاستخدامها في برامج تربية القطن. ولهذا الغرض تم تقييم ثمانية أصناف هي جيزة 45 ، جيزة 70 ، جيزة 80 ، جيزة 83 ، جيزة 86 ، جيزة 88 و جيزة 90 وثلاث سلالات مبشرة من الهجين جيزة 45 x جيزة 83 (السلالة رقم 1 ، 2 ، 3) وكلها تتبع القطن المصري وذلك خلال موسمي الزراعة 2005 و 2006 في محطة التجارب والبحوث الزراعية التابعة لكلية الزراعة – جامعة عين شمس بشلقان – محافظة القليوبية.

وقد تم تقييم الثبات باستخدام ثلاثة عشر مقياساً من مقاييس الثبات المختلفة وهي: المتوسط ، معامل الانحدار، متوسط مجموع مربعات الانحرافات عن خط الانحدار، المكافئ البيئي، معامل التحديد، تباين الثبات، ثبات المحصول، دليل التفوق، معامل الاختلاف النسبي، التباين البيئي بالإضافة للمقاييس غير المعيارية وذلك لصفة محصول القطن الزهر لأحد عشر تركيباً وراثياً والتي قيمت تحت 18 بيئة مختلفة (موسمين ، ثلاثة مواعيد زراعة وثلاث كثافات نباتية) والتي استخدمت لتقييم سلوك وثبات التراكيب الوراثية وكذلك دراسة العلاقات المتبادلة بين هذه المعايير.

أظهرت النتائج وجود تباين كبير بين التراكيب الوراثية التي تأثر أداءها معنوياً بواسطة المتغيرات التي حدثت في المواسم ، مواعيد الزراعة والكثافات النباتية والتفاعلات بينها. وقد أثبتت نتائج تحليل الثبات إن تأثير كلاً من البيئة والتفاعل بين التراكيب الوراثية والبيئة كان عالي المعنوية وهذا يشير إلى إن هذه التراكيب تتفاعل مع الظروف البيئية لصفة محصول القطن.

هذا وقد كانت كلاً من الاستجابة الخطية وغير الخطية للتفاعل بين التركيب الوراثي والبيئة مهمة في التعبير عن هذه الصفة ولكن الاستجابة الخطية كانت المكون الأكبر. ومن الجدير بالذكر أن معايير الثبات كانت مختلفة في تحديد ثبات التراكيب الوراثية.

كما أظهرت تحليلات الثبات أن الصنف جيزة 90 و السلالة (1) هما تركيبان ثابتان وكلاهما كان متفوقاً في كلاً من الغلة والثبات واظهرا مدى واسع من الأقلمة للظروف البيئية ويمكن أن يعتبرا مصدراً مهماً لتحسين الثبات في صفة المحصول.

ومن خلال دراسة الارتباط بين معايير الثبات يمكن أن يستخدم متوسط سلوك التراكيب الوراثية كأداة مبسطة لقياس الثبات لصفة محصول القطن عندما يزرع تحت بيئات مختلفة.

المجله المصريه لتربية النبات ١٢ (٢): ١ – ١٣ (٢٠٠٨)