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Assessment of phenotypic and genotypic stability for seed and lint cotton yields of some cotton cultivars

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ABSTRACT

Fourteen field experiments were conducted during the two successive seasons of 2014 and 2015 at seven different locations from the Northern Delta of Egypt i.e., (Kafr El-Sheikh, El-Beheira and Domietta) to Middle and Southern the Delta of Egypt (El-Menoufia, Dakahlia, El-Gharbia and Sharkiea), to evaluate eight Egyptian cottons included two long stable genotypes; Giza 86 and Giza 94 and six extra–long staple; Giza 45, Giza 87, Giza 88, Giza 92, Giza 93 and Giza 96. Analysis of variance for randomized complete block design with four replications was done for each location. Then combined analyses of variance were calculated for eight cultivars, seven locations over two growing seasons**.** The statistical analysis for phenotypic and genotypic stability was carried. Concerning Giza 86, Giza 87, Giza 88, Giza 92 and Giza 93 cultivars which are considered the most desired cultivars occupy the most areas cultivated by high production of seed cotton and lint cotton yields. However, Giza 96 had the widest range of environmental index for seed cotton yield and lint cotton yield. While Giza 45 had the closest one for seed cotton yield and lint cotton yield. The environments were the most important source of variation explaining 91.92% and 90.92% of the variance for seed cotton yield and lint cotton yield, respectively, followed by the cultivars which explained 5.37% and 6.35% from the source of variation for seed cotton and lint cotton yields, respectively and the interaction between the cultivars and environment represented 2.71% and 2.73% from the source of variation for the two traits, respectively. With respect to the two cultivars, Giza 87 and Giza 88 their bi values do not significantly differ from the unity (bi = 1) and had deviation from regression (S^2di) not significantly differ from zero and their lint cotton yields exceeded the average overall genotypes, which indicated average stability and relative adaptability of the cultivars pointed out. The great variation of the cultivars to the estimated λi statistics suggested that the relatively unpredictable components (the deviation from the linear response) of the cultivar x environment interaction variance may be more important than the relatively predictable component (the coefficient of linear response). Results illustrated that all studied cultivars for both seed cotton and lint cotton yields are sensitive to environmental changes and these cultivars are expected to give high yields either for seed cotton or lint cotton under favorable environmental conditions.

Keywords: *Gossypium barbadense*, Stability, Phenotypic, Genotypic, Seed Cotton, Lint Cotton Yields, environmental index.

INTRODUCTION

The potential genotypes are usually evaluated at different environments to select stable ones. When the performance based on the ranking of genotypes across environments is not constant it represents the major challenge for a breeding program. Thus, screening genotypes for stability under varying environments is very important. Eberhart and Russell (1966) described that a desirable cultivar is one, which has a high mean yield, regression coefficient (bi) close to unity and a small (close to zero) variance due to deviation from regression (S^2d). It is generally agreed that the more stable genotypes can somehow adjust their phenotypic responses to provide some measures of uniformity despite environmental fluctuations (Campbell and Jones 2005; Hauge *et al*.,2011) and Abro *et al.* (2020) found that the genotype effects were significant for all traits, except lint percentage and also, found that no traits had significant genotype x environment interaction. Mahrous (2012) reported that the estimation of genotypic stability revealed varying degrees of stability for the different genotypes. Shaker (2013) illustrated that the phenotypic stability for the promising strain (10229 x Giza 86) was above average or average stable and ranked first in stability for seed cotton and lint cotton yields (k/f). Singh *et al*. (2014) noticed that the genotype x environment mean squares were significant for seed cotton yield, indicating different responses of the genotypes in different environments. El-Seidy *et al*. (2017) and Said *et al. (*2020). concluded that the cultivars; Giza 87, Giza 92 and Giza 96 are considered stable across a wide range of environments. The variety: Giza 94 was more sensitive to any change in the environment and considered as the high yielding environment. The main objective of this study was to assess the impact of genotypes, environment, and their interactions on seed cotton and lint cotton yields. Additionally, the study aimed to determine the level of stability in both phenotypic and genotypic traits.

MATERIALS AND METHODS

Materials of this study included two long staple cultivars; Giza 86 and Giza 94, in addition to, six extra–long staple cultivars; Giza 45, Giza 87, Giza 88, Giza 92, Giza 93 and Giza 96 belonging to *Gossypium barbadense* L. These cultivars were grown at seven locations extending from the Northern Delta of Egypt; (Kafr El-Sheikh, El-Beheira and Domietta) to Middle and Southern of the Delta of Egypt; (El-Menoufia, Dakahlia, El-Gharbia and EL- Sharkiea), over the two growing seasons of 2014 and 2015. The experimental design was a randomized complete block design with four replications at each location. Each entry was grown in plot containing five ridges four meters long and 70 cm wide and a distance between hills of 25 cm intra–spacing. Afterwards, hills were thinned to two healthy seedlings hill after six weeks of sowing. The yield was obtained from three middle rows of each plot. The cultivars were evaluated for their degree of phenotypic and genotypic stability for seed cotton and lint cotton yields. Analysis of variance (ANOVA) for randomized complete blocks design was done according to Senedecor and Cochran (1982) for each location. Then, combined analyses of variance were calculated for eight genotypes, seven locations and two growing seasons in the case of homogeneity variance as outlined by Bartlett, (1937). Differences between means were compared by using the least significant differences (L.S.D.). The analysis of stability was calculated as follows:

Eberhart and Russell (1966) emphasized that optimal yield stability measured through regression approaches would be represented by a cultivar with high mean yield, regression coefficient (bi), close to unity and a small (close to zero) variance due to deviation from regression (S^2d). Tai (1971) also determines the linear response of a genotype to the environmental effects (α_i) and the deviation from the linear response (λ_i). A perfectly stable genotype is that in which (α_i and λ_i) = (-1, 1).

RESULTS

The data presented in Tables (1) and (2) and Fig (1 and 2) revealed that, mean of seed cotton and lint cotton yields of eight cultivars varied among environment and ranged from 4.11 k/fad for the environment 7 (S1L7) to 15.82 k/fad for the environment 9 (S2L2) and from 4.67 k/fad for the environment 7 (S1L7) to 18.31 k/fad for the environment 9 (S2L2), respectively.

Table 1. The mean performances and environmental index for seed cotton yield (k/fad.)

Genotype / Environ.	Giza 86		Giza94		Giza 45		Giza 87		Giza 88		Giza 92		Giza 93		Giza 96		Average overall	E.I.
	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.		
S_1L_1	13.88	5.10	11.71	3.65	12.35	5.33	11.79	3.70	12.32	3.91	14.69	6.30	14.83	6.22	12.21	4.70	12.97	4.86
S_1L_2	5.22	-3.55	6.33	-1.73	3.67	-3.34	4.94	-3.15	4.01	-4.4	4.22	-4.17	3.77	-4.82	3.58	-3.93	4.47	-3.64
S_1L_3	7.40	-1.37	7.92	-0.14	9.40	2.38	6.78	-1.31	7.79	-0.62	7.91	-0.48	7.85	-0.76	8.42	0.91	7.93	-0.17
S_1L_4	10.98	2.21	8.83	0.77	5.47	-1.55	10.80	2.71	10.89	2.48	6.35	-2.04	11.19	2.58	6.73	-0.78	8.91	0.80
S_1L_5	10.34	1.57	11.17	3.11	5.75	-1.27	8.59	0.50	8.31	-0.1	8.47	0.08	6.54	-2.07	5.84	-1.67	8.13	0.02
S_1L_6	12.47	3.70	10.66	2.60	11.08	4.06	12.43	4.34	9.17	0.76	10.17	1.78	8.07	-0.54	6.16	-1.35	10.03	1.92
S_1L_7	5.55	-3.22	3.70	-4.35	3.90	-3.11	5.31	-2.77	3.71	-4.69	3.27	-5.12	4.38	-4.21	3.05	-4.44	4.11	-3.99
S_2L_1	8.60	-0.17	5.44	-2.62	7.03	0.01	6.90	-1.19	8.20	-0.21	10.95	2.56	8.37	-0.24	7.38	-0.13	7.86	-0.25
S_2L_2	16.74	7.96	15.53	7.47	10.48	3.46	15.23	7.14	18.35	9.94	16.33	7.93	16.12	7.51	17.74	10.23	15.82	7.71
S_2L_3	7.95	-0.82	8.81	0.75	9.49	2.47	7.63	-0.46	6.93	-1.47	4.58	-3.81	7.35	-1.26	6.98	-0.53	7.47	-0.08
S_2L_4	4.64	-4.13	4.02	-4.04	3.07	-3.94	5.60	-2.49	6.21	-2.2	5.99	-2.40	5.68	-2.91	4.81	-2.7	5.13	-3.10
S_2L_5	5.37	-3.40	6.23	-1.83	5.15	-1.86	4.71	-3.38	8.51	0.1	10.11	1.72	10.02	1.41	8.08	0.57	7.27	-0.83
S_2L_6	8.18	-0.59	7.37	-0.69	7.22	0.2	7.95	-0.14	8.04	-0.37	8.66	0.27	8.60	-0.01	8.04	0.53	7.01	-0.10
S_2L_7	5.48	-3.29	5.11	-2.95	4.17	-2.84	4.58	-3.50	5.27	-3.13	5.77	-2.62	7.71	-0.9	6.07	-1.41	5.52	-2.58
Grand mean	**8.77**		**8.06**		**7.02**		**8.09**		**8.41**		**8.39**		**8.61**		**7.51**		**8.05**	
L.S.D. : 0.01	**2.293**																	

L1: Kafr El-Sheikh. L 2: El-Gharbia. L 3: Domietta. L 4: EL-Sherkeia. L 5: EL-Beheira. L 6: EL-Dakahlia. L 7: EL-Menufia.
S1: 2014; **S2**: 2015; **k/f** :157.5 kg

Table 2. The environmental index for lint cotton yield (k/fad.)

Genotype / Environ.	Giza 86		Giza94		Giza 45		Giza 87		Giza 88		Giza 92		Giza 93		Giza 96		Average overall	E.I.
	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.	$\bar{x}$	E.I.		
S_1L_1	16.58	6.33	13.44	4.27	13.99	6.19	14.28	4.74	14.49	4.82	16.65	7.01	17.31	7.26	15.23	5.99	15.25	5.83
S_1L_2	5.94	-4.31	7.08	-2.09	3.94	-3.87	5.67	-3.85	4.46	-5.20	4.72	-4.91	4.35	-5.70	4.35	-4.88	5.06	-4.35
S_1L_3	8.52	-1.73	9.21	0.05	10.59	2.79	7.74	-1.80	9.02	-0.65	8.98	-0.66	8.87	-1.18	10.34	1.1	9.16	-0.26
S_1L_4	12.96	2.71	9.97	0.81	6.15	-1.66	12.82	3.29	12.40	2.74	7.34	-2.30	13.12	3.07	8.29	-0.95	10.38	0.96
S_1L_5	11.90	1.65	12.75	3.57	6.47	-1.34	9.95	0.42	9.29	-0.37	9.74	0.10	7.34	-2.71	7.12	-2.12	9.57	-0.01
S_1L_6	14.40	4.15	12.03	2.87	12.21	4.41	14.51	4.98	10.40	0.73	11.66	2.03	9.32	-0.73	7.49	-1.74	11.50	2.04
S_1L_7	6.41	-3.83	4.23	-4.94	4.23	-3.58	6.10	-3.44	4.17	-5.50	3.66	-5.97	5.04	-5.01	3.51	-5.73	4.67	-4.75
S_2L_1	10.11	-0.14	6.20	-2.97	7.97	0.16	8.26	-1.27	9.45	-0.22	12.72	3.08	9.61	-0.44	9.02	-0.22	9.17	-0.25
S_2L_2	19.29	9.03	17.44	8.28	11.64	3.84	17.71	8.17	21.04	11.37	18.82	9.18	18.63	8.57	21.88	12.64	18.31	8.89
S_2L_3	9.39	-0.86	9.95	0.79	10.42	2.62	9.21	-0.32	8.31	-1.35	5.20	-4.43	8.60	-1.45	8.76	-0.48	8.73	-0.69
S_2L_4	5.36	-4.89	4.51	-4.65	3.40	-4.40	6.49	-3.05	7.15	-2.52	7.12	-2.52	6.54	-3.51	5.70	-3.53	5.78	-3.63
S_2L_5	6.33	-3.92	7.20	-1.96	5.75	-2.06	5.65	-3.89	9.74	0.07	11.58	1.93	12.53	2.48	10.13	0.9	8.61	-0.81
S_2L_6	9.71	-0.54	8.47	-0.70	7.92	0.11	9.55	0.02	9.32	-0.35	9.76	0.13	10.00	-0.05	10.11	0.87	9.36	-0.06
S_2L_7	6.60	-3.65	5.84	-3.33	4.59	-3.21	5.54	-4.00	6.10	-3.57	6.97	-2.67	9.45	-0.60	7.39	-1.85	6.56	-2.86
Grand mean	10.25		9.17		7.81		9.53		9.67		9.64		10.05		9.24		9.44	
L.S.D. : 0.01	2.293																	

L1: Kafr El-Sheikh. L 2: El-Gharbia. L 3: Domietta. L 4: EL-Sherkeia. L 5: EL-Beheira. L 6: EL-Dakahlia. L 7: EL-Menufia.
S1: 2014; **S2**: 2015; **k/f** :50 kg

The same trend of results could be observed with respect to Giza 86, Giza 87, Giza 88, Giza 92 and Giza 93 which considered as the most desired cultivars occupies the most areas cultivated by high production of seed and lint cotton, where their yields exceeded the average overall cultivars. However, Giza 96 had the widest range of environmental index (- 4.44 to 10.23) for seed cotton yield and (-5.73to 12.64) for lint cotton yield. While Giza 45 had the closest one (-3.94 to 5.33) for seed cotton yield and (-4.40 to 6.19) for lint cotton yield. The environmental indices were negative at Domietta and El-Menufia locations in both seasons and at El-Gharbia location in the first season, which may indicate that these locations considered as less favorable condition for seed cotton yield as well as lint cotton yield. On the other hand, the environmental indices were positive at Kafr El-Sheikh location in the first season and at El-Gharbia location in the second season, indicating the favorable conditions of these environments for high yields of both seed and lint cotton.

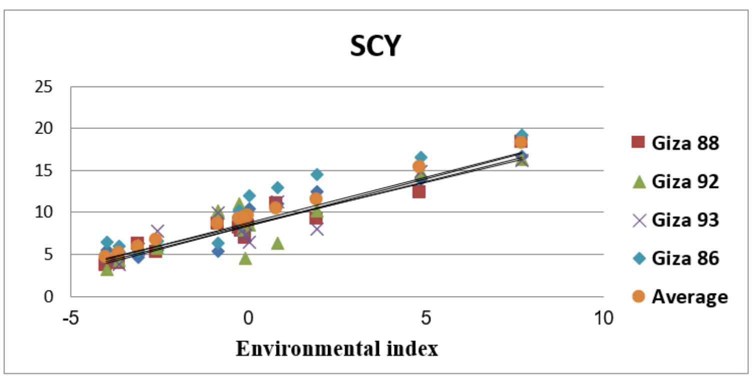

Fig. 1. The environment index for seed cotton of four cultivars over

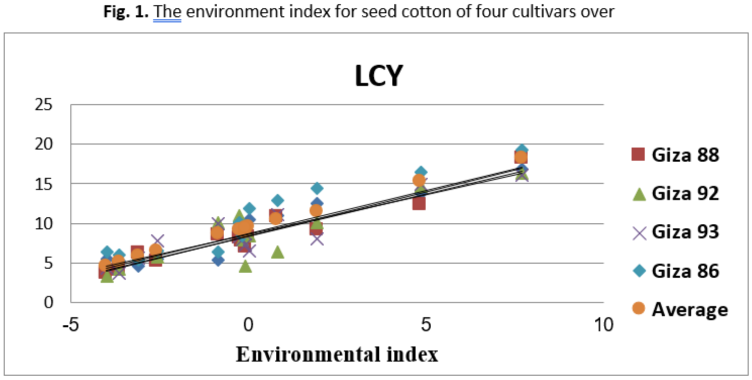

Fig.2. The environment index for lint cotton of four cultivars over
Where: L1: Kafr El-Sheikh. L 2: El-Gharbia. L 3: Domietta. L 4: EL-Sherkeia. L 5: EL-Beheira. L 6: EL-Dakahlia. L 7: EL-Menufia.
S1: 2014; S2: 2015; k/f :50 kg

From the data listed in Table (3) it could be observed that the cultivar x environment interaction mean squares were highly significant, indicating that it is possible to determine the degree of genotypic stability for each cultivar. The environments were the most important source of variation explained 91.92% of the variance for seed cotton yield and 90.92% of the variance for lint cotton yield, followed by the cultivars which explaining 5.37% and 6.35% from the source of variation for seed cotton and lint cotton yields, respectively and the interaction between the cultivars and environment represented 2.71% and 2.73% from the source of variation for the two traits, respectively.

Table 3. Combined analysis of variance for seed cotton yield and lint cotton yield of eight cultivars over fourteen environments.

S.O.V	d.f	Seed cotton yield		lint cotton yield	
		M.S	M.S(%)	M.S	M.S(%)
Environments	13	29410962.9** (MSE)	91.92	4028323.49**(MSE)	90.92
Block/Env	42	322417.5** (MSB)		46249.00** (MSB)	
Cultivars	7	1717231.3** (MSC)	5.37	281360.20** (MSC)	6.35
Cult. x Env.	91	861213.1** (MS)	2.71	120983.97** (MS)	2.73
Error	294	162308.5 (E)		23296.17 (E)	

**: significant at 0.01 probability level.

Analysis of variance for phenotypic stability Table (4) revealed that, environment + (cultivar x environment) interaction source of variation was partitioned into the environment (linear), cultivar x environment (linear) which referred as sum of square due to regression, bi and unexplainable deviation from regression (pooled deviation mean square, S^2d). The data in Table (4) revealed that, both linear and nonlinear components of variation were highly significant either for seed cotton or lint cotton yields, The linear proportion of variance was 44.64% and 50.98% from the total variance (linear and non-linear components for seed cotton and lint cotton yields, respectively.

Table 4. Mean squares of joint regression Analysis for seed cotton yield and lint cotton yield of eight cultivars evaluated at fourteen environments.

S.O.V	d.f	M.S	
		Seed cotton yield	lint cotton yield
Cultivars	7	171231.31**	281360.20**
Env. + (G. x Env.)	104	1107483.00**	152350.35**
Env. linear	1	95585629.30**	13092051.34**
G. x Env. linear (Het.among regression)	7	155423.40**	27721.89**
Pooled deviation (residual)	96	192756.60**	26649.29**
Error Pooled	336	45580.53	6541.44
Linear proportion of variance (%)		**44.64**	**50.98**

** Significant at 0.01 probability level.

The data presented in Table (4) pointed out also that, mean square due to environment (linear) and linear cultivars x environments interaction were highly significant for both traits in view. The first effect means that, differences in environments (locations) will generate disparities in cultivar responses, while the latter effect indicates that there are genetic divergences among cultivars considering their responses variation on environmental conditions.

Pooled deviation (residual) mean squares were highly significant for seed as well as lint cotton yield, indicating that the major components for differences in stability were due to deviation from linear function.

According to, Eberhart and Russell, (1966) and Perkins and Jinks (1968) methods, the regression coefficient (bi) values of the eight cultivars used in this study ranged from 0.7675 for Giza 45 cultivar to 1.1172 for Giza 88 cultivar with respect to seed cotton yield (Table 5). While the same value ranged from 0.7456 for Giza 45 cultivar to 1.1450 for Giza 96 cultivar for Lint cotton yield Table 6. The parameters of αi and λi as the proposed by Tai (1971) were also calculated herein as the parameters measures genetic stability (Tables 5 and 6). In this procedure, the principle of structural relationship analysis, the cultivar by environmental interaction effect of a cultivar was partitioned into two components. These were the linear response to environmental effects and the deviation from the linear response.

Table 5. Average of **seed cotton yield (k/f),** phenotypic (b_i, S^2d_i) and genotypic (α_i,λ_i) stability parameters for cotton genotypes across fourteen environments.

Genotypes	Mean ($\bar{x}$)	Phenotypic stability		Genotypic stability		b_i-1	Dev.M.S. / MSE/r
		bi ± S.E.	S^2d_i	α_i	λ_i		
Giza 86	8.77	1.0882 ± 0.69	0.516**	0.089	3.294	0.088	2.59
Giza 94	8.06	0.9443 ± 0.44	0.883**	-0.056	4.802	-0.056	3.51
Giza 45	7.01	0.7675 ± 1.83	1.684**	-0.235	7.944	-0.233	6.54
Giza 87	8.09	0.9431 ± 0.45	0.776**	-0.058	4.363	-0.057	3.24
Giza 88	8.41	1.1172 ± 0.92	0.288*	0.118	2.362	0.117	1.79
Giza 92	8.39	1.0731 ± 0.58	1.415**	0.074	6.976	0.073	4.39
Giza 93	8.60	1.0054 ± 0.04	0.916**	0.005	4.935	0.005	3.94
Giza 96	7.51	1.0613 ± 0.48	0.997**	0.062	5.267	0.061	4.47
Average verall	8.11						
L.S.D. 0.01	0.726						

**: significant 0.01 probability level, respectively.

The linear response to environmental effects was measured by statistic (αi) and the deviation from the linear response was measured by another statistic (λi). Tai (1971) predicted that (bi-1) approaches αi when the size of MSB is much smaller than MSE (Table 3). This occurs when large number of cultivars and/or large range of environments are tested. In the present investigation, MSE was much larger than MSB and because the larger number of environments (fourteen) more than the number of the cultivars (eight) used, the values of (bi-1) were approaches or slightly larger than αi values and the Dev.MS / MSE /r were smaller than λi statistics (Table 5 and 6) as expected by Tai's model (1971).The differences in the computation of the phenotypic and genotypic stability statistics were quite to each other. However, the data of genotypic stability either shown in Tables 5 and 6 or Fig. 5 and 6 illustrated that all the studied cultivars for both seed cotton and lint cotton yields are sensitive to environmental changes and these cultivars are expected to give high yields either for seed cotton or lint cotton under favorable environmental conditions.

Table 6. Average of **lint cotton yield (k/f),** phenotypic (b_i, S^2d_i) and genotypic (α_i,λ_i) stability parameters for cotton cultivars across fourteen environments.

Genotypes	Mean ($\bar{x}$)	Phenotypic stability		Genotypic stability		b_i-1	Dev.M.S. / MSE/r
		bi ± S.E.	S^2d_i	α_i	λ_i		
Giza 86	10.25	1.0846± 0.66	0.236**	0.086	3.321	0.085	3.51
Giza 94	9.17	0.9085 ± 0.72	0.366**	-0.093	4.498	-0.092	3.08
Giza 45	7.80	0.7456 ± 1.99	0.645**	-0.257	7.012	-0.254	5.59
Giza 87	9.54	0.9516 ± 0.38	0.347	-0.049	4.331	-0.048	3.05
Giza 88	9.66	1.1107 ± 0.87	0.085	0.112	1.955	0.111	1.22
Giza 92	9.64	1.0520 ± 0.41	0.583**	0.053	6.467	-0.052	4.60
Giza 93	10.05	1.0020*± 0.02	0.477**	0.002	5.504	0.002	3.43
Giza 96	9.24	1.1450± 1.14	0.477**	0.147	5.495	0.145	4.98
Average verall	9.42						
L.S.D. 0.01	0.867						

**: significant at 0.01 probability level, respectively.

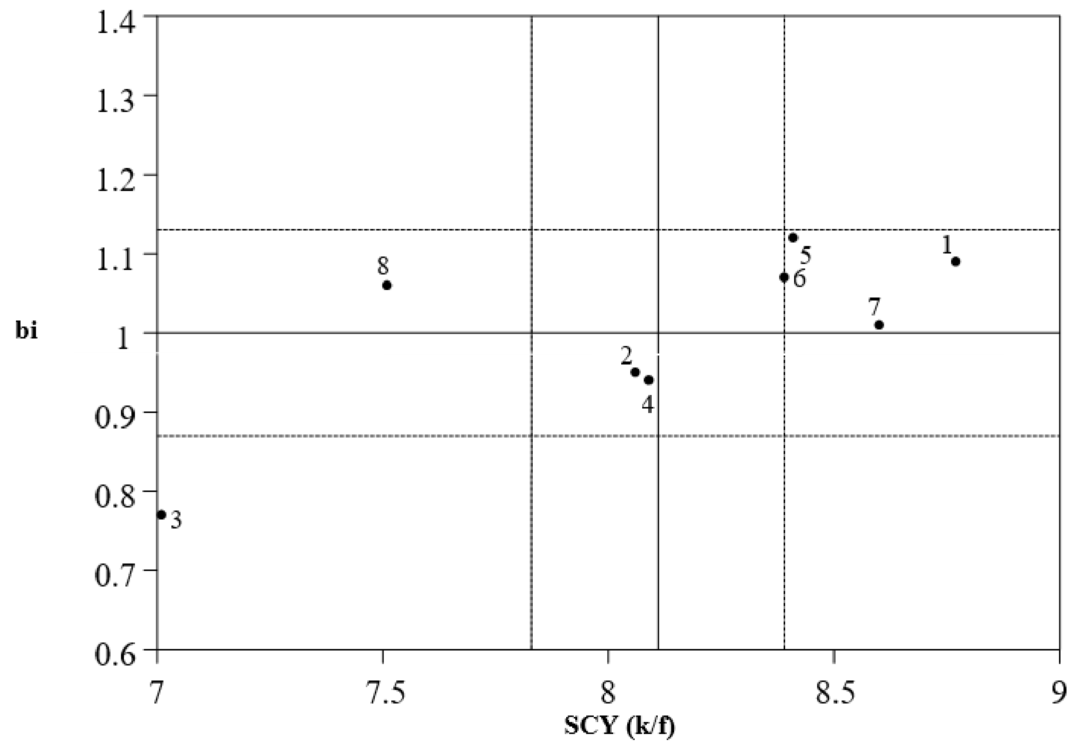

Fig. 3. Relation of seed cotton yield and (bi) of 8 cultivars across 14 environments.

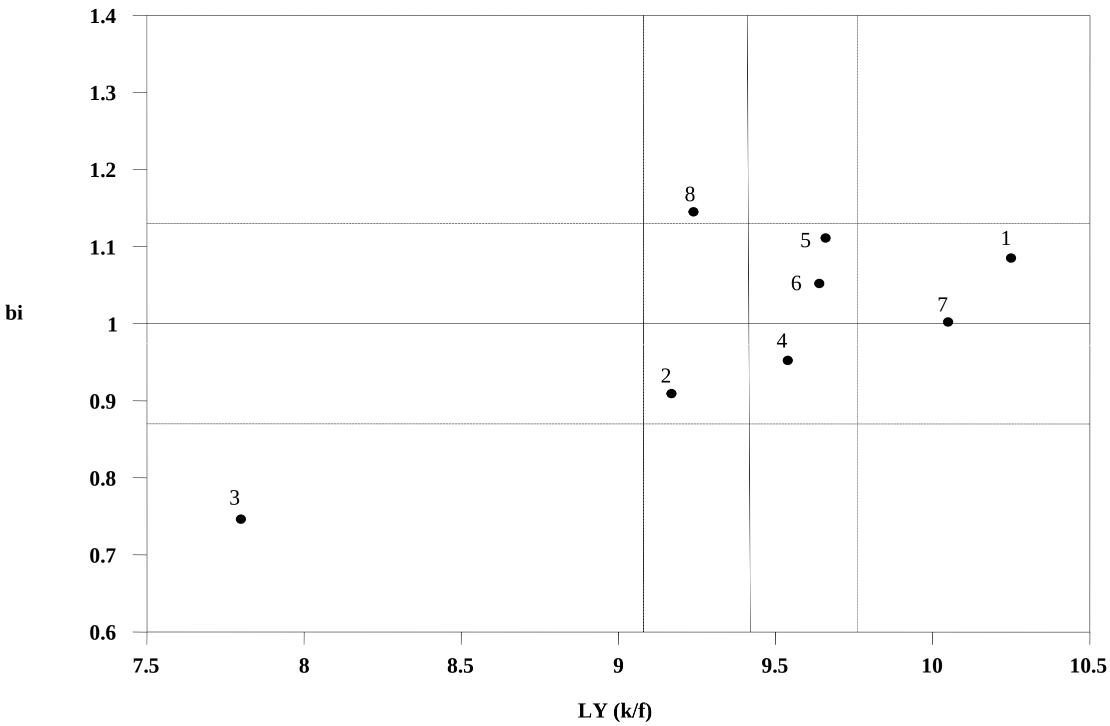

Fig. 4. Relation of lint cotton yield and (bi) of 8 cultivars across 14 environments.

9. Giza 86	5. Giza 88
10. Giza 94	6. Giza 92
11. Giza 45	7. Giza 93
12. Giza 87	8. Giza 96

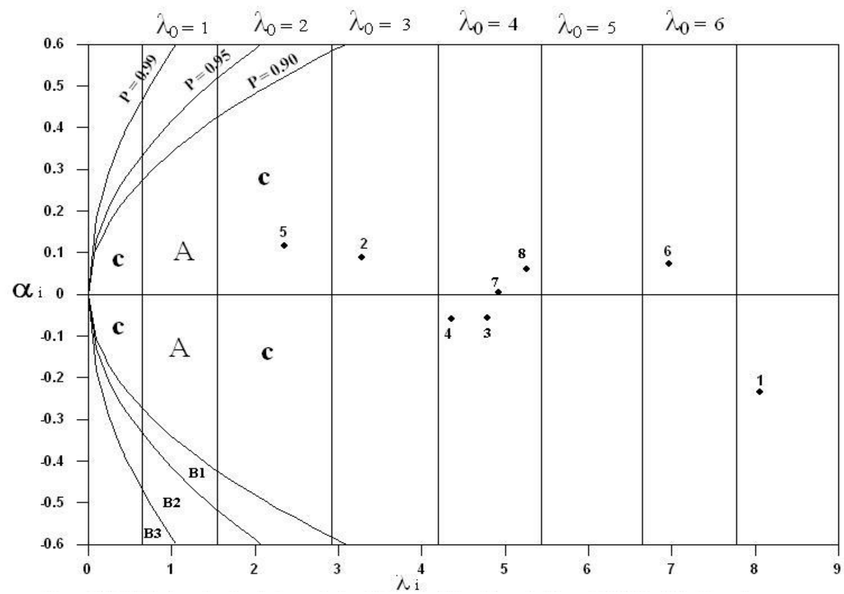

Fig. 5. Distribution of genotypic stability parameters (αi and λi) of 8 cultivars tested at 14 environments for seed cotton yield (k/f).

Where: A: Average Stability at all the probability levels.

B 1: Above Average at (P= 90) and average at (P= 95 and P= 99).

B 2: Above Average at (P= 90 and P= 95) and average at (P= 99).

B 3: Above Average at all the probability levels.

C: Unstable area

5. Giza 86	5. Giza 88
6. Giza 94	6. Giza 92
7. Giza 45	7. Giza 93
8. Giza 87	8. Giza 96

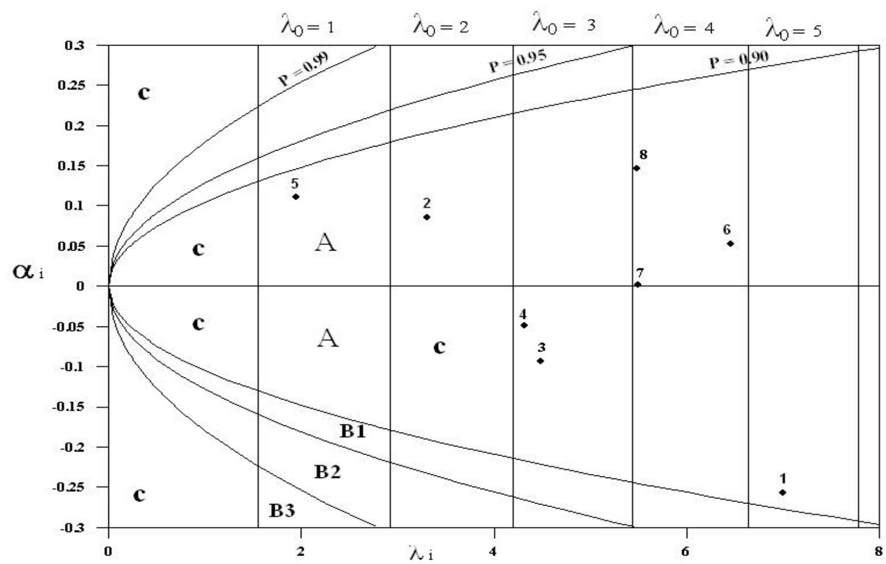

Fig. 6. Distribution of genotypic stability parameters (αi and λi) of 8 cultivars tested at 14 environments for lint cotton yield.

Where: A: Average Stability at all the probability levels.

B 1: Above Average at (P= 90) and average at (P= 95 and P= 99).

B 2: Above Average at (P= 90 and P= 95) and average at (P= 99).

B 3: Above Average at all the probability levels.

C: Unstable area

1. Giza 86	5. Giza 88
2. Giza 94	6. Giza 92
3. Giza 45	7. Giza 93
4. Giza 87	8. Giza 96

DISSCUSIONS

The wide range of environmental index (EI) for seed cotton yield (-3.99 to 7.71) and for lint cotton yield (-4.75 to 8.89) indicated significant variation between environments. The environmental indexes covered a wide range and display a good distribution within the range. Therefore, the assumption for stability analysis is fulfilled (Mather and Calgari, 1974; Becker and Leon, 1988).

The large environments mean squares showed that the influence of environmental effects on mean seed and lint cotton yields is more importance than the differences in cultivar one and by far greater in important than cultivar x environment interactions. However, the highly significance of environment mean squares provide a significant range environment used, and hence validating the environmental requirements suggested by Eberhart and Russell, (1966).

The presence of cultivar x environment interactions indicates that cultivars tended to rank differently in seed cotton as well as lint cotton yields at different environments. Both Linear and Nonlinear components of variation were highly significant for Both studied traits. indicating that the differences among the regression coefficients pertaining to various cotton cultivars on the environmental mean were real and indicated the presence of both predictable and non-predictable components of cultivar x environments interaction. This might indicate that the non- linear components of variation were less than linear components one for seed cotton yield and both equal for lint cotton yield.

Abd El-Moghny and Mariz Max (2015) stated that, the environment variation caused more than 60 % of the total variance on these genotypes, while the genotypes variation caused 3.96 % and 4.341 % for seed cotton yield and lint yield, respectively. This was mainly because of a large range of environments (Tai, 1971).

The main cause of the differences among cultivars in their yield stability traits was the wide occurrence of cultivars x environments interaction (Eberhart and Russell, 1966 and Freeman and Perkins, 1971). A similar trend of results was found by Hassan *et al*. (2000) Abdallah*et al.* (2011). Naveed *et al*., (2006) came to the same conclusion. Therefore, it may be concluded that the relatively unpredictable component of the interaction may be more important than the predictable ones. In this respect, the investigators proved that environmental variation can be classified into predictable and unpredictable variations (Mead *et al*., 1986; Beeker and Leon, 1988). These variations in bi values suggested that these cotton cultivars responded differently to the different environments.

Among the joint regression stability measures, S^2di was largely used to rank the relative stability of cultivars (Becker and Leon, 1988). The indication was that bi could be used to describe the general response to the goodness of environmental conditions, whereas S^2di measures the yield stability. Moreover, Beeker *et al*. (1982) regarded mean square for deviation from regression (S^2di) to be the most appropriate criterion for measuring phenotypic stability in an agronomical sense, because this parameter measures the predictability of genotypic reaction to environments. Langer *et al*. (1979) suggested that the regression coefficient (bi) was a measure of response to varying environments. From these points of view, all the studied cultivars had values of deviation from regression (S^2di) significantly differ from zero for seed cotton yield (Table 5 and Fig 3), indicating sensitivity to environmental changes. These results expected ones due to larger of non- linear components of variation than linear components ones for seed cotton yield and both equal for lint cotton yield as shown in (Table 6 and Fig 4) which indicated the great role of non- predictable components of cultivars x environments interaction. The method of Finlay and Wilkinson (1963)

. These assumptions were in accordance with the two cultivars; Giza 87 and Giza 88 for lint cotton yield, where their bi values did not significantly differ from the unity (bi = 1) and had a deviation from regression (S^2di) not significantly differ than zero and their lint cotton yields exceeded the average overall cultivars, which indicated average stability and relative adaptability of the cultivars pointed out.

However, the great variation in the λi statistics did suggest that the unpredictable components of the cultivar-environment interaction variance may be more important than the relatively predictable component, which confirmed the previous results shown in Table (4). These results were confirmed by that reported by Allam *et al*., (2008). However, the data of genotypic stability either shown in Tables 5 and 6 or Fig. 5 and 6 illustrated that all the studied cultivars for both seed cotton and lint cotton yields are sensitive to environmental changes and these cultivars are expected to give high yields either for seed cotton or lint cotton under favorable environmental conditions. These results are in good agreement with those reported by Killi and Harem (2006), Mahrous (2012), El-Kadi et el. (2013) and Abd El– Moghny and Mariz Max (2015).

CONCLUSION

The two cultivars, Giza 87 and Giza 88, had similar bi values close to unity (bi = 1) and showed no significant deviation from regression (S^2di) compared to zero. Additionally, their lint cotton yields were higher than the average of all genotypes, indicating that these cultivars have average stability and relative adaptability. The considerable variation in the estimated λi statistics suggests that the unpredictable components of the cultivar x environment interaction variance may be more significant than the predictable component. The results showed that all the cultivars studied were sensitive to environmental changes. These cultivars are expected to yield high amounts of either seed cotton or lint cotton under favorable conditions.

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قياس الثبات المظهرى و الوراثى للمحصول وبعض مكوناته لبعض أصناف القطن المصرى

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تهدف هذه الدراسة إلى تقييم ثماني تراكيب وراثية في بيئات مختلفة لمعرفه أفضل هذه التراكيب الوراثية لكل منطقة وقياس ثبات المحصول ومكوناته. وتشمل هذه التراكيب الوراثية صنفين من طبقة الأقطان طويلة التيلة هي جيزة 86 وجيزة 94 بالإضافة إلى ست تراكيب وراثية فائقة الطول هى جيزة 45 ، جيزة 87 ، جيزة 88 ، جيزة 92 ، جيزة 93 ، جيزة 96. تم زراعة هذه التراكيب الوراثية خلال موسمي 2014، 2015فى سبع مناطق بالوجه البحريهفى محافظات كفرالشيخ ، الغربية ، دمياط ،الشرقية ، البحيرة ، المنوفية. وتم مقارنة التراكيب الوراثية فى كل منطقة فى تصميم القطاعات الكاملة العشوائية لمحصول القطن الزهر والقطن الشعرفأربع مكررات. كما أجرى التحليل المشترك للتراكيب الوراثية فى السبع مناطق لسنتى الدراسة وقد تم تقدير معامل التباين البيئى ودرجة الثبات المظهرى ولثبات الوراثى.

1.أظهرت النتائج أن صفتىمحصولى القطن الزهر والقطن الشعر للثمانى أصنافتأثرت معنوياً بالبيئات وان التفاعل بين الأصناف × البيئة كان معنويا.

2.أشارت النتائج إلى وجود تباين بين البيئات نتيجة للمدى الواسع للمعامل البيئى (EI) لمحصولى القطن الزهر والقطن الشعر. هذا المدى الواسع للمعامل البيئى يسمح بتوزيع جيد خلال هذا المدى. حيث تشغل الأصناف جيزة 86 ، جيزة 87 ، جيزة 88 ، جيزة 92 ، جيزة 93 معظم المساحة القطنية ذات الإنتاجية العالية لمحصولى القطن الزهر والقطن الشعر ، بينما جيزة 45 أقلها فىمحصولى القطن الزهر والقطن الشعر.

3.أظهرت النتائج أن المصدر الرئيسي للتباين راجع لتباين البيئات حيث أعطت 91.92 % و 90.92 % من التباين الكلى لمحصولى القطن الزهر والقطن الشعر على الترتيب ، ثم يلى ذلك تباين الأصناف حيث ساهمت بنسبة 5.37 % و 6.35 % من التباين الكلى لمحصولى القطن الزهر والقطن الشعر على الترتيب ، وساهم التباين الراجع للتفاغل بين الأصناف × البيئات بنسبة 2.71 % و 2.73 % من التباين الكلى لمحصولى القطن الزهر والقطن الشعر على الترتيب.

4.أوضحت نتائج الثبات المظهري أن كلاً من مكونات التباين الخطى (Linear) والغير خطى (nonlinear)كانا عاليا المعنوية لمحصولى القطن الزهر والقطن الشعر مما يدل على أن الإختلافاتفى معاملات الإنحدار الخاصة بتنوع الأصناف فى متوسط البيئات حقيقى ، ويدل أيضا على وجود كلاً من المكونات للعوامل التى يمكن التنبأ بها والعوامل الغير متنبأ بها فى التفاعل بين الأصناف × البيئات.

5.يدل التباين فى قيمة معامل الإنحدار(bi) للثمانية أصناف تحت الدراسة على إختلافإستجابة هذه الأصناف بإختلاف البيئات.

6.أظهرت كل الأصناف انحراف عن معامل الإنحدار(S2di) عن الصفر معنوياً لمحصول القطن الزهر مما يدل على حساسية هذه الأصناف للتغير البيئى. هذه انتائج المتوقعة نتيجة أن مكونات التباين الغير خطى أكبر من مكونات التباين الخطى لمحصول القطن الزهر بينما يتساويان لمحصول القطن الشعر والتى تدل على أهمية مكونات الغير متنبأ بها للتفاعل بين الأصناف × البيئات. وعلى ذلك يتوقع أن تعطى هذه الأصناف محصول عالى تحت ظروف بيئية جيدة. وأعطى محول القطن الشعر نفس النتيجة للأصنافجيزة 86 ، جيزة 94 ، جيزة 45 ، جيزة 92 ، جيزة 93 ، جيزة 96.

7.بالنسبة للصنفانجيزة 87 ، جيزة 88 فإن قيمة معامل الإنحدار(bi) غير معنوية حيث تختلف اكبر من الواحد (bi = 1) ،كما أن الإنحراف عن معامل الأنجدار(S2di) غير معنوى حيث يختلف عن الصفر ومحصول القطن الشعر يزيد عن متوسط الأصناف كلها حيث تدل على ثبات متوسط و الأقلمة النسبية للأصناف ما يلفت النظر.

8.حسب معاملى(αi) و (λi) كعوامل لقياس درجة الثبات الوراثي(Tai, 1971) حيث أوضح أن (bi – 1) تقترب من قيمة (αi) عندما يكون تباين التكرارات(MSB) أصغر من تباين الخطأ (MSE). وهذا يظهر عندما يكون عدد الأصناف كبير وعدد البيئات المختبرة كبير. وفى هذه الدراسة كان تباين الخطأ (MSE) اكبر من تباين التكرارات(MSB) نتيجة لان عدد البيئات أكبر (14) من عدد الأصناف (8) تحت الدراسة. قيمة (bi – 1)يقترب من أن يكون أكبر من قيمة (αi) وانحراف MS/MSE/r أصغر من القيمة المحسوبة لقيمة (λi) .

9.التباين الكبير للأصناف فى قياس (λi) يدل على أن المكون الغير متنبأ (الانحراف عن خط الاستجابة) لتباين التفاعل بين الصنف × البيئة ربما يكون أكثر أهمية عن المكون المتنبأ (معامل خط الاستجابة).

10.دلت النتائج على أن كل الأصناف المدروسة حساسة للتغيرات البيئية بالنسبة لمحصولى القطن الزهر والقطن الشعر ، وهذه الأصناف يتوقع لها اعطاء محصول عالى سواء القطن الزهر اوالقطن الشعرفى البيئات مناسبة.

الكلمات المفتاحية: القطن ، الثبات المظهري ،الثبات الوراثي ، المعامل البيئي ، القطن الزهر ، القطن الشعر.