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Evaluation of Egyptian cotton cultivars

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ABSTRACT

Present study was carried out to evaluate 11 cotton varieties under two locations over two growing seasons 2015 and 2016 in Egypt. The results showed that there were significant differences among environment, genotypes, and their interactions for all the studied characters. The variety Giza 94 surpassed all varieties in yield and its components shared with the variety Giza 92 for seed cotton yield. The varieties Giza 94, Giza 92 and Giza 96 recorded highest yield and yield components at Nubariya location. The varieties Giza 87, Giza 88, Giza 92, Giza 93 and Giza 96 recorded highest values at Nubariya location for most fiber characters. Principal component analysis showed that the characters which have relatively high value in the first principal component (PC_1) were earliness percentage, seed cotton yield, lint yield, boll weight, lint percentage, and micronaire reading. The second principal component (PC_2) was principally affected by earliness percentage, fiber length and fiber strength. At the same time, cluster analysis could efficiently describe the characteristics of group of genotypes in different groups. The eleven cotton genotypes were grouped into five major clusters. The obtained results indicated the presence of genetic diversity among the tested cotton genotypes. Genotypes from divergent clusters can be used for hybridization in order to isolate useful recombinants in the segregating generations. This information might be used in the breeding programs for improvement of Egyptian cotton.

Key words: Cotton, Cluster analysis, Evaluation

The environmental factors have the great potential in affecting many characteristics especially quantitative traits such as yield and fiber characters in cotton (Noori *et al*. 2018, 2019). The cotton crop behaves differently under different environmental conditions. Therefore, stability in performance is one of the most desirable characteristics of any genotype to be released for commercial cultivation.

The genotypes × environment (GE) interactions detect different patterns of response among the genotypes across environments (Rajpoot *et al.* 2016a, Noorzai and Choudhary 2017). The efficacy of the genetic divergence as a criterion for choosing parents and suitable combinations has been reported by several investigators (El-Mansy *et al*. 2014, Shaker *et al*. 2016). Thus, the objective of this study was to evaluate 11 Egyptian cultivars for fiber quality to interpret cultivar × environment interactions for cotton yield and fiber quality traits at two locations over two years, and to decipher the extent of genetic variation and relationship among cotton cultivars based on the yield and fiber traits using multivariate analysis which could further be utilized in breeding programs.

MATERIALS AND METHODS

The field experiments were carried out to evaluate and estimate the diversity of 11 genotypes, viz. Giza 85, Giza 86, Giza 89, Giza 94, Giza 45, Giza 70, Giza 87, Giza 88, Giza 92, Giza 93, and Giza 96 at two locations, viz. Kafr El-Sheikh (L_1), and Nubariya (L_2) during the two growing seasons 2014 (Y_1) and 2015 (Y_2). The experimental design was randomized complete design with three replications. The plot size was 7.8 m^2 (3 rows × 4 m length × 0.65 m width). Distance between hills was 25 cm apart and each hill was later thinned to two plants per hill after five weeks from planting date. The cultural practices were carried out as recommended in cotton fields (Rana *et al*. 2014, Choudhary *et al*. 2015). Data for earliness percentage (EI %), seed cotton yield (SCY) in kentar per feddan (Kentar = 157.5 kg), lint cotton yield (LCY) in kentar per feddan Kentar = 50 kg), boll weight (BW, g), lint percentage (LP %) etc. were collected as per the standard procedures (Rana *et al*. 2014, Choudhary *et al*. 2015). Samples of lint cotton from each genotype at each location were analyzed to determine fiber quality in all samples.

Statistical analysis: Combined analysis for each character under the study was done across the four environments (Y_1 L_1, Y_1 L_2, Y_2 L_1, and Y_2 L_2) to study the interaction of the genetic effects with the environments. The significant differences between means were carried out using LSD. All above mentioned analyses was statistically analyzed as outlined by Gupta *et al.* (2016) and cluster analysis was presented in graphical and dendrogram

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presentations. These computations were performed using (SPSS procedure, 2016).

RESULTS AND DISCUSSION

The climatic conditions of Egypt are different from year to year and from one location to another. The cotton crop behaves differently under different environmental conditions (Paul *et al*. 2016, Rajpoot *et al*. 2019) therefore, evaluation of the most desirable characteristics of any genotype to be released for commercial cultivation is very important. The genotype × environment interaction detects different patterns of response among the genotypes across environments (Rajpoot *et al*. 2016 b).

The results of statistical analysis showed that the mean squares were highly significant for environments, genotypes and genotype × environment interaction for all characters. This could be due to high environmental variations and genotypes × environments interaction for all the studied characters, indicating that genotypes considerably varied across different environments. The significant genotype × environment interaction indicating the presence of variability among the genotypes as well as environments under which the experiments were conducted. Results are in agreement with Rahomah *et al.* (2008) who found highly significant means squares for genotypes. Abdel-Salam *et al.* (2014) found that the effect of genotypes and genotype × environment interaction were significant for cotton yield, boll weight, lint percentage seed index, lint index and hallo length. Hamoud (2008) found that the environment, genotype and interaction between them were significant for seed cotton yield. Shaker *et al.* (2016) found that highly significant men squares values were obtained for genotypes of cotton yield, boll weight, seed index, lint percentage, lint index and hallo length. On the other hand, significant of genotypes indicated the presence of genetic variability for these materials.

Effect of the environments: Data (Table 1) showed that the earliness percentage (EI%) exhibited the lowest mean values in the first year under both locations. The average values of seed cotton yield and fiber strength were the highest values at Nubariya location in two seasons. Also the Nubariya environment gave the highest values for lint yield, boll weight and fiber length in the first year. The highest lint percentage was at Nubariya in the second year and Kafr El-Sheikh in the first year. The best micronaire reading were at Nubariya in the second year. These results are in agreement with those reported by El Ganayny (2017).

Effect of varieties: Data exhibited the mean values of the studied varieties for yield and lint quality. The cotton varieties were significant different from each other for most studied traits under different environment conditions. The new variety Giza 94 was superior over all cotton cultivars and varieties for earliness index and yield traits under two locations and years. With respect to lint quality traits, the extra-long varieties Giza 93 followed by Giza 87, Giza 88 and new variety Giza 96 gave the best values for fiber quality traits. The results are in agreement with those obtained by El-Ganayny (2017).

Genotype × environment interaction: Data (Table 2) showed that the varieties Giza 94, Giza 87, Giza 88, Giza 92, Giza 93 and Giza 96 were earlier than the other varieties. The variety Giza 94 recorded the highest seed cotton yield and lint yield at Nubariya location in the two seasons, Giza 94 surpassed in boll weight at Nubariya location in the two seasons shared with significantly Giza 86 at Kafr El-Sheikh location in the first season. Concerning lint percentage, the variety Giza 94 surpassed all genotypes at the two locations. The Giza 87, Giza 88, Giza 93 and Giza 96 recorded the highest fiber length and fiber strength at Nubariya location in the first season; in addition two varieties Giza 92 and Giza 93 recorded highest values for fiber strength at Nubariya location in the second season. Data indicated that the variety Giza 93 recorded best micronaire reading during the two seasons at the two locations. These results are harmony with those obtained by Abd El-Aziz (2015), El-Ganayny (2017) and Rajpoot *et al*. (2018).

Cluster analysis based on the relative similarity among 11 genotypes with eight characters is presented in Fig 1. It

Table 1 The mean values of different cotton genotypes for all the studied traits under two locations over two years 2014 and 2015

Genotype	Ear, %	SCY, K/F	LCY, K/F	BW, g	LP, %	FL, mm	MR	FS, g/tex
Giza 85	67.33	10.00	12.03	3.35	38.20	31.90	4.60	41.41
Giza 86	64.45	10.78	13.29	3.30	39.46	33.73	4.38	45.78
Giza 89	63.00	9.98	11.77	3.32	37.42	32.23	4.73	39.99
Giza 94	72.65	12.45	15.70	3.57	40.41	34.42	4.14	45.13
Giza 45	51.33	6.93	7.02	2.77	32.12	34.98	3.43	40.90
Giza 70	52.17	7.85	9.13	2.88	36.87	35.77	4.30	41.30
Giza 87	59.31	10.64	11.26	2.86	33.14	35.83	3.49	46.57
Giza 88	69.08	9.27	10.68	2.86	37.85	36.38	3.79	48.23
Giza 92	66.78	11.63	13.22	2.98	36.19	34.93	3.61	47.50
Giza 93	65.38	9.02	9.83	2.68	35.03	37.07	2.92	48.24
Giza 96	72.13	10.92	13.48	3.12	39.23	35.40	3.93	45.83
LSD (0.01)	5.09	1.21	1.50	0.22	0.89	1.00	0.17	1.98

Table 2 Effect of genotypes × environments interaction for studied characters in two growing seasons 2014 and 2015

Genotype	Kafr El-Sheikh		Nubariya		LSD 0.01	Kafr El-Sheikh		Nubariya		LSD 0.01
	Y1	Y2	Y1	Y2		Y1	Y2	Y1	Y2	
	Earliness percentage					*Seed cotton yield*				
Giza 85	64.67	64.67	71.67	68.33	10.19	9.93	9.93	10.07	10.07	2.41
Giza 86	42.70	84.43	44.00	86.67		8.73	8.67	11.73	14.00	
Giza 89	61.67	61.67	65.33	63.33		10.00	10.00	9.97	9.97	
Giza 94	53.90	88.37	60.00	88.33		10.87	9.57	15.80	13.57	
Giza 45	50.00	52.67	50.00	52.67		6.27	7.60	6.27	7.60	
Giza 70	50.33	50.33	51.67	56.33		7.70	7.70	8.00	8.00	
Giza 87	41.87	77.03	46.67	71.67		8.33	9.20	11.93	13.10	
Giza 88	49.33	85.33	55.67	86.00		8.50	7.13	12.87	8.57	
Giza 92	50.83	81.93	50.33	84.00		10.13	10.10	15.97	10.33	
Giza 93	52.70	79.13	53.00	76.67		7.57	7.70	11.27	9.53	
Giza 96	54.63	85.57	61.00	87.33		10.30	9.10	14.97	9.30	
	Lint cotton yield					*Boll weight*				
Giza 85	12.00	12.00	12.07	12.07	3.01	3.33	3.33	3.37	3.37	0.45
Giza 86	11.17	11.00	14.63	16.37		3.50	3.00	3.40	3.30	
Giza 89	11.77	11.77	11.77	11.77		3.33	3.33	3.30	3.30	
Giza 94	14.17	12.77	19.43	16.43		3.43	3.23	3.93	3.67	
Giza 45	6.27	7.77	6.27	7.77		3.00	2.53	3.00	2.53	
Giza 70	8.87	8.87	9.40	9.40		2.80	2.80	2.97	2.97	
Giza 87	10.00	9.77	12.13	13.13		2.57	2.73	3.13	3.00	
Giza 88	9.13	9.07	15.20	9.30		2.83	2.47	3.27	2.87	
Giza 92	11.87	11.83	17.80	11.37		2.80	2.87	3.43	2.83	
Giza 93	8.37	9.37	11.90	9.67		2.33	2.53	2.90	2.97	
Giza 96	13.00	11.63	18.37	10.90		2.90	3.00	3.53	3.03	
	Lint percentage					*Fiber length*				
Giza 85	38.33	38.33	38.07	38.07	1.79	31.77	31.77	32.03	32.03	1.99
Giza 86	40.53	40.50	39.60	37.20		33.97	33.03	34.47	33.47	
Giza 89	37.37	37.37	37.47	37.47		32.13	32.13	32.33	32.33	
Giza 94	41.57	42.50	39.07	38.50		34.20	34.90	34.17	34.40	
Giza 45	31.70	32.53	31.70	32.53		34.83	35.13	34.83	35.13	
Giza 70	36.57	36.57	37.17	37.17		36.77	36.77	34.77	34.77	
Giza 87	34.77	33.83	32.20	31.77		34.57	35.03	38.50	35.20	
Giza 88	38.73	40.53	37.47	34.67		35.37	36.27	38.40	35.50	
Giza 92	37.13	37.17	35.47	35.00		32.17	34.67	36.10	36.77	
Giza 93	35.27	38.93	33.73	32.20		34.67	37.97	38.47	37.17	
Giza 96	40.17	40.50	39.03	37.20		34.57	34.67	38.07	34.30	
	Micronaire reading					*Fiber strength*				
Giza 85	4.53	4.53	4.67	4.67	0.35	39.63	41.60	42.20	42.20	3.97
Giza 86	4.73	4.30	4.90	3.60		45.37	43.07	45.43	49.27	
Giza 89	4.77	4.77	4.70	4.70		38.80	39.50	40.83	40.83	
Giza 94	4.20	4.20	4.17	4.00		43.87	41.90	48.00	46.77	
Giza 45	3.67	3.20	3.67	3.20		40.87	40.93	40.87	40.93	
Giza 70	4.30	4.30	4.30	4.30		40.80	40.80	41.80	41.80	
Giza 87	3.03	3.23	3.60	4.10		45.67	43.83	52.27	44.50	
Giza 88	3.77	4.00	4.10	3.30		49.17	46.00	49.50	48.27	
Giza 92	3.50	3.47	4.17	3.30		48.67	43.33	49.00	49.00	
Giza 93	2.80	2.70	3.27	2.90		45.87	45.83	50.77	50.50	
Giza 96	4.03	4.20	4.10	3.40		44.97	41.33	50.27	46.77	

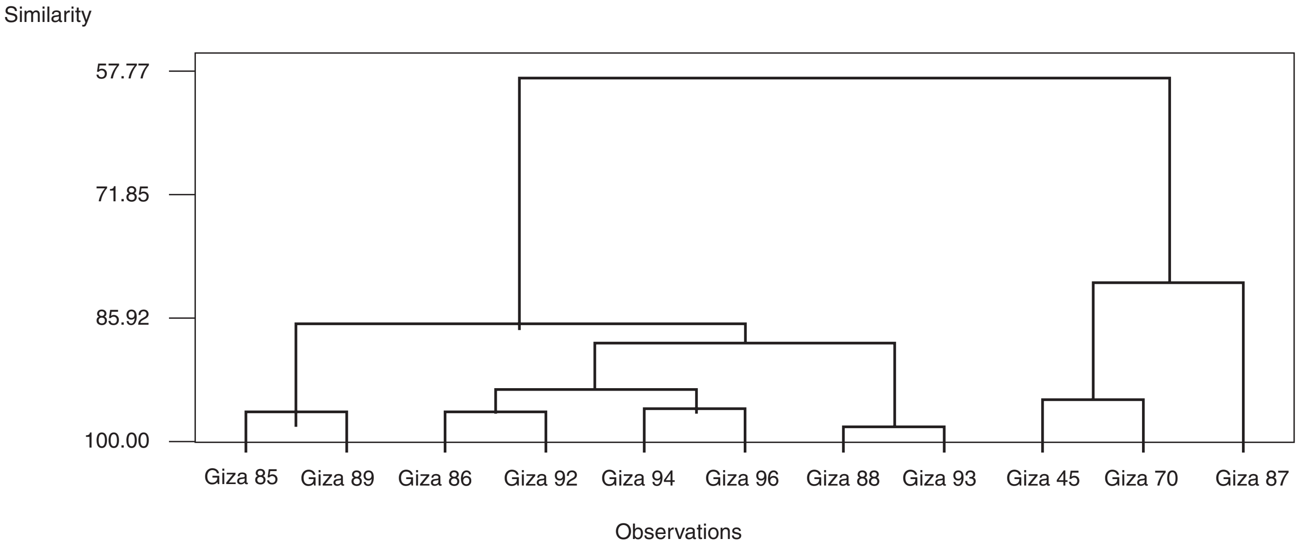

Fig 1 Cluster analysis for eight characters of 11 genotypes.

is clear that the 11 cotton cultivars were grouped into SIX major groups. The varieties Giza 85 and Giza 89 (Cluster 1), Giza 86 and Giz 92 (Cluster 2) and (Giza 94 and Giza 96 (Cluster 3) and both Giza 88 and the variety Giza 93 (Cluster 4), while Giza 45 and the newest variety Giza 70 (Cluster 5), and Giza 87 (Cluster 6). These varieties were widely divergent from the other genotypes. These groups were different for yield, fiber length. Representative genotypes may be chosen from the particular groups for hybridization programs with other approved cultivars. This will aid in identification, selection and combining genotypes to obtain important characters in one line with a broad genetic base. El-Feki *et al.* (2005) found that their genotypes were divided into two groups which were jointed at the distance level 16.49. El- Adly *et al.* (2006) concluded that variety Giza 88 was very different from all other genotypes and the most distant from the others. While Giza 83 and Giza 90 genotypes had the lowest genetic distance and closest than the others. However, cluster analysis could efficiently describe the characteristics of group of genotypes in different groups.

The results of the present study indicated the presence of genetic diversity among the tested cotton genotypes. Therefore, the genotypes from divergent clusters can be used for hybridization in order to isolate useful recombinants in the segregating generations.

Overall, the new variety Giza 94 surpassed all varieties in yield and yield components followed by Giza 92 for seed cotton yield. Meanwhile, the varieties Giza 94, Giza 92 and Giza 96 recorded highest values for yield and yield components at Nubariya location. On the other hand, the Giza 87, Giza 88, Giza 92, Giza 93 and Giza 96 recorded highest values at Nubariya for most of the studied fiber characters, while Giza 70 recorded highest values for fiber length at Kafr El-Sheikh location. Also, multivariate data analysis is useful in identifying the diversity genotypes and the important traits to isolate the alike genotypes to be used in breeding programs.

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