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IMPROVEMENT OF YIELD AND LINT CHARACTERISTICS OF SOME EGYPTIAN COTTON VARIETIES UNDER STRESS CONDITIONS

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ABSTRACT

Field experiments were carried out during two successive seasons 2002 and 2003 on saline sandy soils at El-Maghara Research Station, Desert Research Center, North Sinai to study the effect of genetic variations of some cotton varieties i.e. Giza 45, Giza 70, Giza 83 and Giza 85) and some different foliar application treatments , i.e. $ZnSO_4$ 0.1%, MnSO4 1.0%, $FeSO_4$ 0.5% and tap water as control on yield, yield components, lint quality and some biochemical genetic markers of some cotton varieties. A split plot design with three replications was used. The main plots were devoted at random to four spray-foliar application treatments and four cotton varieties, in the sub plots. The obtained results could be summarized as follows:

The result indicated that genetic variability were detected clearly among the four cotton varieties in yield, yield components and lint quality. Giza 83 cultivar exhibited a significant higher values and considered the highly yield and its attributes. Generally, foliar application treatments may correct the metabolic disturbance under stress conditions of El-Maghara, Agric. Research Station (sandy and saline soil). Foliar applications by $ZnSO_4$ 0.1%, MnSO4 1.0% , and $FeSO_4$ 0.5% led to improve growth parameters, yield, yield components and lint quality of all cotton varieties as compared with the control during both seasons. $ZnSO_4$ 0.1% surpassed the other spray treatments for increasing all studied parameters of cotton varieties under investigation. Also $ZnSO_4$ 0.1%, combined with Giza 83 cultivar interaction achieved the best treatment .The Extra long staple varieties had longer , stronger and finer than the long staple varieties. Also, micronutrients (Zn^{+2}, Mn^{+2} and Fe^{+2}) as a foliar application exhibited a slight improve for fiber properties.

Random amplified polymorphic DNA (RAPD) and five random 10-mer primers were used to amplify DNA *via* polymerase chain reaction (PCR), 31 RAPDs were generated and 15 (48.4%) were polymorphic.Similarity matrix was generated from RAPD results Dendrogram generated by UPGMA analysis, detected that long stable varieties layed near each other. The same was true with extra-long stable ones. Also, each variety had its unique RAPD markers. The same was true in case of SDS. Protein markers. In-addition, newly synthesised bands either under deficiency or applications of different micronutrients, could be used as marker – assisted selection for higher yield varieties under this conditions. The obtained results could be used by cotton breeders and producers to got higher yield and lint percentage or have lint qualities.

Key words: Adaptation - Biochemical genetic markers - Cotton varieties - PCR, DNA markers - Foliar application – Genetic variability – Lint quality- Protein Markers – RAPD - Yield

INTRODUCTION

Cotton (*Gossypium barbadense* L.) is considered one of the most important economical fiber crops in Egypt. Increasing cotton production in arid and semi arid regions is considered the main goal in this work.

Generally, the environmental conditions mainly affect cotton gene expression (proteins), growth, yield and lint qualities. So, highly saline soil conditions can significantly reduce these chriteria (Afiah and Ghoneim, 1999 and Badran, 2001), in spite of cotton is classified as salt tolerant plant. Also deficiency of plant available micronutrients (Zn^{+2} , Mn^{+2} and/or Fe^{+2}) caused severe depression in plant growth, development and of final yield (Cakmak *et al.*, 1999), where micronutrients play fundamental role in several critical cellular functions such as protein metabolism, gene activation and expression, structural and functional integrity of biomembranes, photosynthetic activity (Yu and Rengel, 1998; and Shenker *et al.*, 2004).

Also, cotton genotype plays serious role on the growth, yield and gene expression. (Rashed, 2002). So, genotype - environment interaction was found to be significant for these chriteria (EL-Kashlan and Badr, 1998 and Sorour *et al.*, 1998).

Improvement of this fluctuation in yield and lint qualities remaining the largest problem facing cotton breeders and producers in new reclaimed regions. Thus, it is of great importance to assess elite higher yield, lint percentage and qualities cotton varieties under these circumstances. Also, characterize protein (gene expression) and DNA markers with these elite varieties in order to make further improvement in cotton production under stress conditions. Protein and DNA markers using SDS-protein electrophoresis analysis and RAPD technique, respectively, and growth and yield characters were used extensively to identify and study the genetic characters of cotton varieties (Lu and Myers, 2002) and for evaluation of micronutrient status in plants (Khafaga and Rashed 2002 and AL-Shabi *et al.*, 2004). Accordingly the objectives of this study are to detect the performance and genetic markers, variations (cotton varieties) under stress conditions of El-Maghara. Also, to assess growth, yield ,lint characters and some biochemical genetic markers using SDSProtein electrophoresis profiles of improved cotton varieties by foliar application of micronutrients (Zn^{+2}, Mn^{+2} or Fe^{+2}).

MATERIALS AND METHODS

Field experiments were carried out at El- Maghara Research Station of Desert Research Center at North Sinai during 2002 and 2003 growing seasons, to study the effect of four foliar application treatments (i.e. $ZnSO_4$ 0.1%, MnSO4 1.0% , and $FeSO_4$ 0.5%) and tap water as a control on yield, yield components, lint quality and biochemical genetic markers of four cotton varieties (*Gossypium barbadense* L.), i.e. Giza 45, Giza 70 (Extra long staple) and Giza 83 , Giza 85 (long staple). Mechanical and chemical analysis of soil as well as irrigation well water are presented in Table (1). Groundwater (4.06 mmhos) was used through drip irrigation system. Each experiment included 16 treatments, i.e. the combination of four foliar applications and four cotton varieties, which were arranged in a split plot design with three replications. The main plots were occupied by the different foliar application treatments while cotton varieties were arranged in the sub plots.

Table (1): Mechanical and chemical properties of the experimental farm soil and chemical analysis of irrigation well water at El-Maghara Research Station

Type	Textural Class	PH	E.C. mmhos	$CaCO_3$	Cations (meq/100 g)				Anions (meq/10 g)			Fe	Mn	Zn
					Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3	Cl^{-}	SO_4^{-}			
Soil (0-30)	Sand	7.4	2.00	14.7	4.00	1.50	3.30	0.15	1.80	5.20	1.95	6.5	2.3	0.8
Well Water		8.4	4.06	--	11.4	3.48	24.6	0.69	4.40	32.2	3.57	-	-	-

The seeds of cotton variety were obtained from Cotton Research Institute; Agricultural Research Center, Giza, Egypt and were sown in the experimental site at distance of 75 cm between drip irrigation lines and 30 cm. spacing between drippers with two seeds per hill in March 2 and 4 in 2002 and 2003 growing seasons. Cattle organic manure and calcium superphosphate fertilizers were added during soil preparation at the rates of $20m^3$ and 30kg P_2O_5/fed., respectively. Ammonium nitrate (33.5 % N) and potassium sulfate (48 % K_2O) were added at the rate of 75 Kg N and 24Kg K_2O/ fad, as three equal portion at 30, 45 and 60 days after sowing. Foliar application treatments were sprayed twice after 45 and 60 days from sowing using Tween 20 as welting agent. Varieties were evaluated for (plant height (cm), no. of fruiting branches/plant , flowering date, no.of open boll/plant, boll weight (g), 100- seed weight (g), seed cotton weight/plant, lint cotton weight/plant, lint% and seed cotton yield Kg/fed.). Fiber properties in terms fiber length 2.5% (SLmm), uniformity ratio%, fiber strength (g/tex), fiber elongation% and micronaire reading were determined from combined samples of 2003 season yield at the Cotton Research Institute; Agricultural Research Center, Giza, Egypt.

- Polymerase chain reaction (PCR) technique and RAPD analysis.

Genomic DNA was extracted from fresh young leaves of randomly chosen ten plants for each variety, according to the method of Dellaporta *et al.* (1983). All leaves of the ten plants from each variety were bulked prior to extraction. DNA was quantitated by spectrophotometer and gel electrophoresis.

DNA was amplified using oligonucleotide Primers (10-mers) (Table 6), obtained from Operon Technologies (Alamada, Calif.), according to Williams *et al.* (1990).

PCR amplification reactions contained 10mM Tris-HCl with pH 8.8 at 25°C, 50mM KCl, 2.0mM $MgCl_2$, 200µM of each of d NTPs, 0.2 µM 10-mer primer, 10ng template DNA and 0.5 units of Taq DNA polymerase (Promega). Amplifications were performed for 40 cycles of 40s at 94°C, 1 min at 36°C, 1 min at 72°C, and ending with 6 min at 70°C. Amplified DNA products were separated on $14gl^{-1}$ agarose in 1 X TAE buffer (40 mM Tris base, pH 8.0 , 20 mM glacial) acetic acid, 2mM Na EDTA). The run was performed for one hour at 100V in pharmacia submarine.

The fragment size of the amplification products were estimated from the gel by comparison with standard molecular marker (M). M refers to DNA Ladder with 10000, 8000, 6000, 5000, 4000, 3000, 2500, 2000, 1500, 750, 500 and 250 bp.

- SDS – protein electrophoresis analysis.

  Young fully expanded - leaf samples from each treatments and control were sampled at random and ground with liquid nitrogen and mixed with extraction buffer, pH 7.5 (50 mM Tris, 5% glycerol and 14 mM ß-mercaptoethanol) in a morter and pestle and left overnight, then vortexed for 15 sec. and centrifuged at 10.000 rpm at 4°C for 10 min.The supernatants were transfered to new eppendorf tubes and kept in deep freeze until use for electrophoresis analysis .

Protein fractionation were performed on vertical slab (19.8 cm X 26.8cm X 0.2 cm) gel using the electrophoretic method of Laemmli (1970).

- Gel analysis

  Gels were photographed using a 35 mm colour film and scanned with Bio-Rad video densitometer Model 620 at wave length of 577. Software data analysis for 620 densitometer is used as recommended by the manufacture.

- Statistical analysis
- All data were subjected to the proper statistical analysis of variance according to the procedure outlined by Steel and Torrie (1960). The mean values were compared at 0.05 level of probability by Duncan\s multiple range test of mean separation (Duncan, 1955).

DNA amplification profiles of four cotton varieties were compared with each other and bands of DNA fragments were scored as present 1 or absent 0. The data for all four primers was used to estimate genetic distances on the basis of the number of shared amplification products (Nei and Li, 1979). A dendrogram based on dissimilarity coefficients was generated by using the unweighted pair group method of arithemetic means (UPGMA).

RESULTS AND DISCUSSION

Effect of performance of varieties:

There were significant differences in all yield and its attributes among Egyptian cotton varieties under sandy and saline soil Table (2). Giza 83 variety recorded the highest mean values for no. of fruiting branches/plant, no. of open boll/ plant, flowering date, boll weight (g), seed cotton weight g/plant, lint cotton weight g/plant, lint % and seed cotton yield Kg/fed. in 2002 growing season. Whereas Giza 85, and Giza 45, cotton varieties ranked in the second and third order respectively. On the other hand, Giza 70 variety surpassed other varieties for plant height . However , during the 2nd season, Giza 83 tack the same trend while Giza 45 was better than GiZa 85 in plant height (cm), no. of open boll/ plant, boll weight (g), ,lint cotton weight g/plant , lint % . Also, Giza 45 recorded the best variety for early flowering date as compared the other varieties during both seasons.

Egyptian cotton varieties under investigation differed greatly in yield and its components under saline irrigation water . These differences could be due to the ability of cultivars to reduce NaCl accumulation in their cells that enables the varity to thrive well under saline conditions which reflected on yield and its components (Sorial and Malash, 1997; El-Samahy, (2000). El-Razaz *et al* (1997) found that Giza 83 was the best cultivar for seed cotton yield /fed. under drip irrigation and sandy soil. Also, Afiah and Ghoneim(1999) reported that Giza 83 and Giza 45 surpassed other varieties for yield and its components under saline soil and irrigation with saline well water. In the same direction Badran (2001)showed that, Giza 45 , Giza 83, and Dendera seemed to be the best varieties for such trait. These results are in harmony with thoth obtained by Munk and Roberts 1995; Makram *et al* 1996 and El-Razaz *et al* 1997. On the other hand, the retarding effect of salinity on yield and its components of cotton varieties might be ascribed to the following factors: A). Inability of roots to absorb sufficient amount of water due to the high osmotic pressure of the external saline solution (Meiri *et al.* (1971 and Heikal, 1976). B).High rate of energy consumption in building up the osmoregulatants such as proline, glycine betain ... etc, that would be accumulated in plant cells in concentrations enough to regulate the osmotic pressure between vacuoles and cytoplasm (Bernstein, 1975; Greenway and Munns, 1980 and Munns *et al.* (1982).

Table (2): Main effects of varieties on yield and yield components of Cotton grown under drip irrigation system at El- Maghara in 2002 and 2003 growing season.

Treatments Varieties	Plant height (cm)	No. of fruiting branches/pl	No. of open Bolls/pl.	Flowerin Dats	Boll wt. (g)	100-seed wt (g)	Seed cotton wt . g/ plant	Lint cotton wt. g/ plant	Lint %	Seed Cotton yield kg/ fed
					2002					
Giza 70	103.2 A	5. 52 D	11.24 C	85.80 A	2.51 C	9.61 C	23.94 C	8.73 D	37.00 C	585.9 D
Giza 45	97.3 B	7.81 C	11.87 B	80.64 C	2.83 B	9.89 B	24.18 C	9.37 C	39.06 B	699.5 C
Giza 83	99.9 B	9.62 A	13.02 A	85.35 A	2.95 A	9.71 BC	29.18 A	11.73 A	40.56 A	821.5 A
Giza 85	86.2 C	8.73 B	12.14 B	84.04 B	2.78 B	10.26 A	25.45 B	9.61 B	38.44 B	761.6 B
					2003					
Giza 70	101.2 A	5.40 D	11.05 C	85.72 A	2.45 D	9.56 C	23.89 B	8.69 D	36.98 C	577.3 C
Giza 45	99.3 A	7.85 C	11.91 B	81.71 C	2.87 B	9.80 AB	24.41 B	9.45 B	39.10 B	706.6 B
Giza 83	101.2 A	9.63 A	13.07 A	85.37 A	2.97 A	9.72 BC	29.17 A	11.82 A	40.69 A	826.6 A
Giza 85	88.3 B	8.53 B	11.24 C	82.97 B	2.57 C	9.97 A	24.44 B	9.11 C	37.44 C	731.5 B

Effect of foliar application :-

Yield and its components significantly increased with foliar micronutrients treatments ($ZnSO_4$ 0.1%, $MnSO_4$ 1.0% , and $FeSO_4$ 0.5%)) as compared with the control durind both seasons (Table,3). The highest significant values for no. of fruiting branches/plant, no. of open boll/plant, Boll weight (g) and seed cotton yield Kg/fed. were achieved by foliar application with $ZnSO_4$ 0.1% the percentages of increments reached (6.84%, 7.30%, 6.32%and 6.75% respectively) in 2002 and (7.95%, 8.56%, 6.06% and 6.65% respectively) in 2003 as compared with the control. In this respect, the control treatment (without any foliar application) showed the lowest values of yield and its components, as compared with the foliar treatments in both seasons.

Regarding foliar application, several investigators have proved the significant role of some sprayed treatments for correcting the adverse effect of salinity of some field crops (Farrag, 1978; El-Kadi *et al.*, 1979; Dahdoh, 1986). Also, the stimulatory effect of micronutrients on plant growth which reflect on yield and its components it is clearly established that., zinc has an important role in protein synthesis and the synthesis of the growth controlling compound such as indole acetic acid, (Boawn *et al.*, 1957). In addition, manganese participates in O_2 – evolving system of photosynthesis and has a role in the production of chlorophyll (Robertson and Lucas, 1976). Iron has as essential role for the maintenance of chlorophyll in plants and for RNA metabolism of chloroplasts. Also Iron considered to be an essential constituent of leg hemoglobin present in the nodules of plants and is essential in the process of a symbiotic N_2-fixation (Taffin, 1970). These finding are harmony with that obtained by Amara 1998; sallam and Kafaga (1999); Kafaga and Nahed (2002) and Kafaga *et al.* (2002) on some field Crops.

Table (3):Effect of micronutrients foliar application on Yield and its components of cotton varieties grown under drip irrigation system at El- Maghara in 2002 and 2003 growing season.

Treatments Foliar application	Plant height (cm)	No. of fruiting branches /pl	No. of open Bolls/pl.	Days of flowering	Boll wt. (g)	100-seed wt (g)	Seed cotton wt. g / plant	Lint cotton wt. g / plant	Lint %	Seed Cotton yield kg/ fed
	2002									
Control	94.5 a	7.63 d	11.68 d	83.64 c	2.69 d	9.78 c	25.25 b	9.64 c	38.63 a	692.2 d
$ZnSO_4$ 0.1%	100.0 a	8.19 a	12.60 a	84.27 a	2.86 a	9.96 a	26.29 a	10.07 a	38.88 a	738.9 a
$MnSO_4$ 1.0%	96.6 b	8.04 b	12.13 b	84.05 ab	2.78 b	9.89 b	25.73 b	9.92 ab	38.79 a	722.6 b
$FeSO_4$ 0.5%	95.5 b	7.81 c	11.86 c	83.87 bc	2.73 c	9.84 b	25.48 b	9.82 bc	38.75 a	710.8 c
	2003									
Control	94.8 b	7.55 c	11.45 d	83.65 b	2.64 c	9.66 c	25.03 c	9.54 c	38.39 b	688.4 d
$ZnSO_4$ 0.1%	102.3 a	8.15 a	12.43 a	84.32 a	2.80 a	9.86 a	26.01 a	9.98 a	38.74 a	734.2 a
$MnSO_4$ 1.0%	97.0 b	7.91 b	11.80 b	83.96 ab	2.72 b	9.78 b	25.57 b	9.82 b	38.56 ab	715.0 b
$FeSO_4$ 0.5%	95.8 b	7.79 b	11.59 c	83.85 ab	2.69 bc	9.74 b	25.29 bc	9.72 b	38.52 ab	704.4 c

Effect of interaction:-

Data in table (4) revealed that, there was a significant interaction effect between different cotton varieties and foliar application treatments on yield and yield components. During the 1^{st} season, Giza 83 combined with $ZnSO_4$ 0.1% recorded the highest mean values for no. of fruiting branches/plant, no. of open boll/plant, boll weight (g), seed cotton weight g/plant, lint cotton weight g/plant, lint% and seed cotton yield Kg/fed.. Whereas Giza 70 variety combined with $ZnSO_4$ 0.1%, foliar application was the superlative treatment, which achieved the highest mean value in plant height (cm). However, Giza 85 combined with the same spray gave the higher rate for 100- seed weight (g). Meanwhile durin 2^{nd} season Giza 83 combined with $ZnSO_4$ 0.1% tack the same trend which achieved during 1^{st} season. On tle same direction Giza 45 combined with $ZnSO_4$ 0.1% spraying application was the best treatment which achieved the highest mean value of plant height. Also Giza 45 combined with all trace elements under investigation interaction achieved higher significant values for yield and some its components as compared with Giza 70.

Table (4) : Effect of interaction between Egyptian cotton varieties and foliar application treatments on growth , yield and its components in 2002 and 2003 seasons.

Treatments: Varieties	Treatments: Foliar	Plant height (cm)	No. of fruiting branches/ pl.	No. of open boll/plant	Flowering dates	Boll wt. (g)	100-seed wt (g)	Seed cotton wt g/ plant	Lint cotton wt g/ plant	Lint %	Seed Cotton yield kg/ fed
		2002									
Control	Giza 70	102.80 A-C	5.19 F	10.76 C	85.44 A-C	2.43 F	9.52 D	23.16 E	8.52 G	37.01 E	554.20 I
	Giza 45	95.67 EF	7.54 D	11.78 B	80.33 E	2.75 DE	9.76 B-D	24.02 C-E	9.20 D-F	38.99 CD	684.50 G
	Giza 83	95.67 EF	9.18 B	12.21 B	84.89 A-D	2.93 AB	9.65 D	28.76 A	11.43 B	40.40A-C	801.80A-D
	Giza 85	83.87 H	8.61 C	11.98 B	83.89 D	2.65 E	10.17 A-C	25.08 B-D	9.42 CD	38.14 DE	744.30 D-F
$ZnSO_4$ 0.1%	Giza 70	105.07 A	5.83 E	12.37 B	86.30 A	2.65 E	9.69 CD	24.84 B-D	8.91 E-G	37.03 E	628.4 0 H
	Giza 45	100.03 A-E	7.97 D	11.96 B	81.00 E	2.91 A-C	10.02 A-D	24.38 C-E	9.52 CD	39.15 B-D	713.30 E-G
	Giza 83	*103.03 AB*	10.13 A	13.77 A	85.62 AB	2.97 A	9.77 B-D	29.79 A	12.01 A	40.76 A	839.00 A
	Giza 85	*90.67 FG*	8.83 BC	12.30 B	84.18 B-D	2.92 AB	10.37 A	26.15 B	9.82 C	38.59 D	774.90 B-D
$MnSO_4$ 1.0%	Giza 70	*102.07 A-C*	5.60 EF	10.95 C	85.80 A	2.50 F	9.65 D	24.21 C-E	8.83 FG	37.00 E	592.60 HI
	Giza 45	*97.00 C-E*	7.89 D	11.90 B	80.74 E	2.86 A-D	9.91 A-D	24.21 C-E	9.42 CD	39.06 B-D	703.30 FG
	Giza 83	*101.00 A-E*	9.88 A	13.47 A	85.58 AB	2.95 A	9.72 B-D	29.16 A	11.79 AB	40.56 AB	827.70 AB
	Giza 85	*85.83 GH*	8.79 BC	12.21 B	84.09 CD	2.81 B-D	10.27 A	25.35 BC	9.64 CD	38.54 D	766.70 C-E
$FeSO_4$ 0.5%	Giza 70	*101.07 A-D*	5.46 EF	10.90 C	85.67 A	2.45 F	9.59 D	23.55 DE	8.67 G	36.96 E	568.30 I
	Giza 45	*96.33 DE*	7.82 D	11.83 B	80.50 E	2.80 CD	9.87 A-D	24.10 C-E	9.36 C-E	39.04 B-D	696.70 FG
	Giza 83	99.67 B-E	9.82 B	12.63 B	85.31 A-D	2.94 A	9.69 CD	29.01 A	11.70 AB	40.50 A-C	817.70 A-C
	Giza 85	84.33 H	8.67 C	12.08 B	84.00 CD	2.74 DE	10.21 AB	25.24 BC	9.55 CD	38.51 D	760.70 C-E
		2003									
Control	Giza 70	100.7 A-D	5.01 G	10.68 H	85.47 A	2.38 F	9.46 C	23.12 D	8.47 I	36.99 D	543.70 D
	Giza 45	96.00 DE	7.60 E	11.82 D-G	81.33 D	2.79 C	9.67 A-C	24.12 B-D	9.17 D-G	39.01 C	688.80 B
	Giza 83	97.33 C-E	9.20 B	12.31 CD	84.91 A	2.96 AB	9.66 A-C	28.81 A	11.60 B	40.43 AB	807.1 A
	Giza 85	85.33 F	8.40 CD	11.00 GH	82.89 BC	2.44 F	9.85 A-C	24.08 B-D	8.92 GH	37.14 D	714.00 B
$ZnSO_4$ 0.1%	Giza 70	104.00 AB	5.67 F	12.21 CD	86.23 A	2.56 E	9.63 A-C	24.78 BC	8.86 G-I	37.01 D	620.00 C
	Giza 45	106.30 A	8.02 DE	12.02 C-E	82.17 B-D	2.95 AB	9.92 A-C	24.61 B-D	9.610 C	39.20 BC	724.30 B
	Giza 83	104.70 AB	10.22 A	13.82 A	85.64 A	3.00 A	9.78 A-C	29.52 A	12.08 A	41.17 A	844.70 A
	Giza 85	94.00 E	8.71 C	11.66 D-G	83.22 B	2.68 D	10.12 A	25.15 B	9.37 C-F	37.58 D	747.70 B
$MnSO_4$ 1.0%	Giza 70	100.30 B-D	5.51 F	10.60 H	85.63 A	2.44 F	9.60 BC	24.17 B-D	8.80 G-I	36.99 D	584.30 CD
	Giza 45	97.67 C-E	7.93 E	11.96 C-F	81.50 CD	2.90 A-C	9.83 A-C	24.50 B-D	9.54 CD	39.11 C	709.70 B
	Giza 83	102.70 A-C	9.64 B	13.42 AB	85.61 A	2.96 AB	9.73 A-C	29.28 A	11.85 AB	40.61 A	831.30 A
	Giza 85	87.50 F	8.56 C	11.20 E-H	83.11 B	2.60 DE	9.98 AB	24.32 B-D	9.09 E-G	37.55 D	734.70 B
$FeSO_4$ 0.5%	Giza 70	99.67 B-E	5.40 FG	10.70 H	85.57 A	2.40 F	9.53 BC	23.48 CD	8.62 HI	36.94 D	561.00 D
	Giza 45	97.33 C-E	7.86 E	11.87 C-G	81.84 B-D	2.84 BC	9.77 A-C	24.40 B-D	9.49 C-E	39.08 C	703.70 B
	Giza 83	100.00 B-E	9.44 B	12.73 BC	85.33 A	2.96 A	9.70 A-C	29.07 A	11.73 AB	40.55 A	823.30 A
	Giza 85	86.33 F	8.46 CD	11.08 F-H	82.67 B-D	2.55 E	9.94 A-C	24.20 B-D	9.04 FG	37.51 D	729.70 B

From the previous results we notice that there were increments by the application of micronutrients such as (Zn^{+2}, Mn^{+2} and Fe^{+2}) on yield and its components of Egyptian Cotton varieties Giza 83 and Giza 45compared with the control. These finding may be mainly due to the role of trace elements on correct the reduction of micronutrients under saline conditions. These finding are in harmony with that obtained by (Ali, and Maria, 1992). In addition, the efficiency of the application of some trace elements such as $ZnSO_4$, $MnSO_4$ and $FeSO_4$ may be with a corrective and/or compensative effect on mineral balance under saline conditions, (Misra, 1964).

Fiber properties:-

Table (5):Effect of micronutrients foliar application on lint quality of Egyptian cotton varieties grown under saline conditions (El-Maghara , North Sinai) in 2002 growing seasons

Treatments		Fiber length 2.5% SL(mm)	Uniformity ratio %	Fiber strength (g/tex)	Fiber elongation %	Micronaire reading
Foliar	Varieties					
Control	Giza 45	32.20	50.80	32.10	5.80	3.30
	Giza 70	33.70	50.30	30.30	5.80	3.90
	Giza 83	28.60	50.20	28.10	7.00	4.40
	Giza 85	28.40	50.10	30.00	6.80	4.20
Mean		30.73	50.35	30.12	6.35	3.95
$ZnSO_4$ 0.1%	Giza 45	33.00	52.90	33.90	6.90	3.00
	Giza 70	34.00	51.80	32.00	6.88	3.10
	Giza 83	29.00	51.20	31.00	8.15	3.60
	Giza 85	28.80	50.20	31.50	7.90	4.00
Mean		31.20	51.53	32.10	7.46	3.43
$MnSO_4$ 1.0%	Giza 45	32.80	50.80	32.00	5.85	3.00
	Giza 70	33.80	50.30	31.20	5.85	3.20
	Giza 83	28.80	50.30	30.00	7.10	4.00
	Giza 85	28.60	50.10	30.70	6.85	4.10
Mean		31.00	50.38	30.98	6.44	3.58
$FeSO_4$ 0.5%	Giza 45	32.20	50.80	32.00	5.85	3.00
	Giza 70	33.70	50.20	31.30	5.83	3.60
	Giza 83	28.60	50.20	30.10	7.05	4.20
	Giza 85	28.30	50.00	30.80	6.85	4.10
Mean		30.75	50.30	31.05	6.39	3.73
Effect of varieties	Giza 45	32.55	51.33	32.48	6.10	3.07
	Giza 70	33.80	50.65	31.20	6.09	3.45
	Giza 83	28.75	50.48	29.80	7.33	4.05
	Giza 85	28.53	50.10	30.75	7.10	4.10

Generally, Fiber properties of the Egyptian cotton varieties grown under saline conditions at El- Maghara Research Station exhibited a slight different among varieties and with some application trace elements treatments as compared with the control (Table 5). In general , micronutrients (Zn^{+2}, Mn^{+2} and Fe^{+2}) as a foliar application achieved the slight improve for Fiber properties i.e. Fiber length 2.5% (SLmm), Uniformity ratio%, fiber strength (g/tex), Fiber elongation% and micronaire reading as compared with the control. Also, the Extra long staple cultivars; G45 and G70 had longer , stronger and finer than the long staple cultivars G 83 and G 85 . These results are in line with those obtained by Abou-Zeid *et al* (1996) ; Afiah and Ghoneim (1999) and Badran (2001)

Random amplified polymorphic DNA (RAPD) analysis

Out of the oligonucleotide primers screened in this study five primers diaplayed a strong amplification with distinct bands (Table 6 and Figure 1). Such primers amplified a total of 31 DNA fragments, out of these amplicons 15 (48.4 %) were monomorphic. The rest of bands 16 (51.6%) were polymorphic. The number of amplification products generated by each primer within the cotton varieties varied from 6.5 to 38.7 %. The level of polymorphism were differed among different primers. Similar results were obtained by Barakat and Elham, (2004) who distinguished genetic variation among some cotton varieties by using RAPD markers. Also, the RAPD markers generated by the used primers revealed characteristic bands for each cotton variety. In this regard, higher yield (Long stable) varieties were identified by positive unique markers ($B7_{4000,2000}$, $B10_{2000}$, $B1_{5000,4800}$), also the extra long stable varieties have the positive unique marker ($B1_{2000}$).

Table (6) : RAPD primers, total number of amplicons, number of polymorphic amplicons and level of polymorphism detected by the different primers among the four cotton varieties (*Gossypium barbadense* L.)

Primers	Total No. of amplicons	Polymorphic amplicons	Polymorphism
Op-B5	6	3	50.00
Op-B16	4	1	25.00
Op-B7	7	5	71.43
Op-B1	12	6	50.00
Op-B10	2	1	50.00
Total	31	16	51.61
Average	6.2	3.2	

Higher yield and lint percentage of cotton variety (Giza 83) was identified by positive markers ($B5_{2800}$ and $B1_{7500}$). While Giza85 and Giza45 which rank the second and the third among investigated cotton varieties concerning yield and lint % characterized by positive markers ($B5_{4500}$ and $B7_{2600}$) and ($B16_{1500}$) respectively. The lowest yield variety (Giza 70) was identified by negative markers ($B7_{2200 \text{ and } 1000}$).

These bands can be considered as specific of cotton variety and provide additional powerful specific markers for discrimination between the higher yield, and lint % varieties and the varieties with lower values of these chriteria. Lu and Myers (2002) reported that cotton (*Gossypium hirsutum* L.) was individually identified by specific markers in genetic fingerprinting.

The above results were confirmed by statistical analysis. A similarity matrix was generated from the RAPD results using Nei and Li's (1979) coefficient that clearly shown in table (7). These similarity coefficients were used to generate a dendrogran (Fig. 2) by UPGMA analysis in order to determine the groups of different cotton varieties. From the similarity matrix the least similar variety was Giza70. Its similarity ranged from 58 to 54 % with Giza 45 to 83 . On the other hand long stable varieties (Giza 83 and Giza 85) layed near each other. In the same time Giza 85 (long stable) and Giza 45 (extra-long stable) which had intermediate yield and lint % clustered together. Giza70 did not clustered with the other varieties tested and can easily differentiated. The genetic similarity of the studied four cotton varieties ranged between 54 and 78%. These results are in accordance with Rashed (2002).

Table (7): Similarity coefficient across RAPD analysis of the four cotton (*Gossypium barbadense* L.) varieties.

	Giza45	Giza 70	Giza 83	Giza 85
Giza 70	0.58			
Giza 83	0.69	0.54		
Giza 85	0.78	0.57	0.74	

Protein electrophoretic analysis (biochemical genetic markers)

The SDS- PAGE for total protein of the four cotton varieties grown at El-Maghara Research Station, were showed in Fig. (3) and their densitometric analysis is illustrated in table (8). 30 bands were detected in leaves total protein profiles, with approximately molecular weight ranging from 146 to 18 KD. A total of 18 monomorphic bands were detected, where 8 major bands with molecular weights of 97 , 88 , 80 , 66 , 55 , 50 , 44 and 18 KD. These bands were common bands for cotton varieties and could be as species – specific bands. Similar result was obtained by Barakat and Elham (2004). There were slight polymorphism has been identified among extra long stable varieties (Giza 70 and 45) and long stable ones (Giza 85 and 83), where 118, 60 , 52 and 43 KD bands were present in extra long stable varieties and absent in long stable ones. Accordingly, protein banding patterns is a reliable technique for cotton varieties identification and characterization . This is in agreement with Rao *et al.*, (1990) .

The electrophoretic pattern of leaf total protein fractions for long stable cotton varieties (Giza 85 and 83) and extra-long stable ones (Giza 70 and 45) grown at El-Maghara Research station and subjected to foliar application of micronutrients (Zn^{+2}, Mn^{+2} or Fe^{+2}) are shown in Fig. (3) and their densitometric analysis is illustrated in table (8). Higher and lower yield varities exhibited 25 and 21 KD bands under ions deficiency 146, 46 and 32 KD bands by foliar applications of Zn^{+2}, Mn^{+2} or Fe^{+2} So, the results showed that exposing cotton plants growing under stress conditions of El-Maghara Research stations to foliar applications of Zn^{+2}, Mn^{+2} or Fe^{+2} has led to increase in the synthesis of some new bands and decrease in the synthesis of others. Also, the density and intensity were differed from long stable cotton varieties to extra-long stable ones. This is due to either enhancement (transcription and / or post-transcription) or repression of gene expression in these plants (Al-Shabi *et al.*, 2004). There are differential varietal responses to mineral nutrition in higher plants and most of which are genetically controlled (Clark and Brown, 1980).

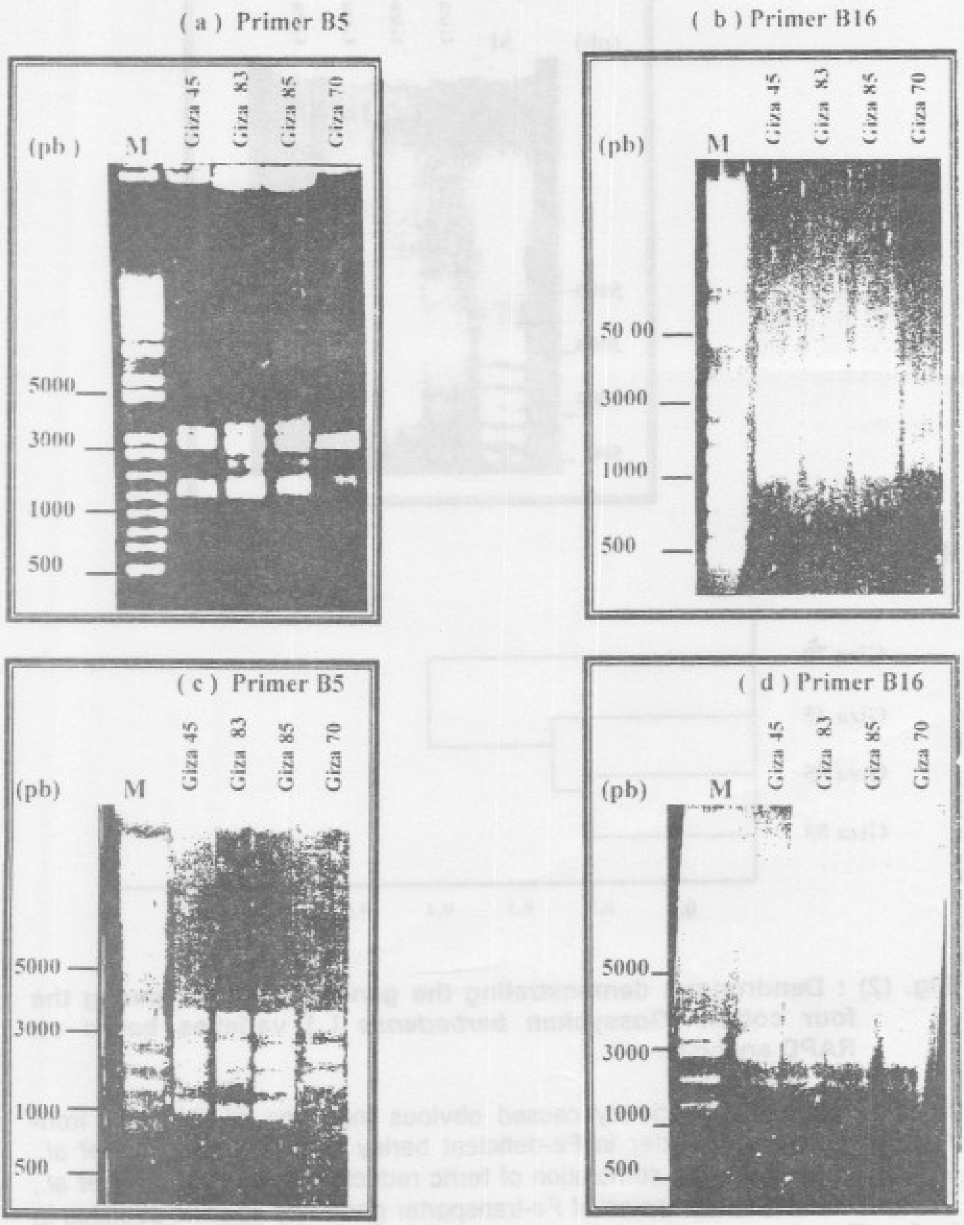

Fig. (1) : DNA polymorphism based on RAPD analysis for the four cotton (*Gossypium barbadense* L.) varieties Giza 45, Giza 70, Giza 83 and Giza 85 using primers (OP) B5 (a), B16 (b), B7 (c), B1 (d) and B10 (e). M refers to DNA standard.

(c) Primer B5

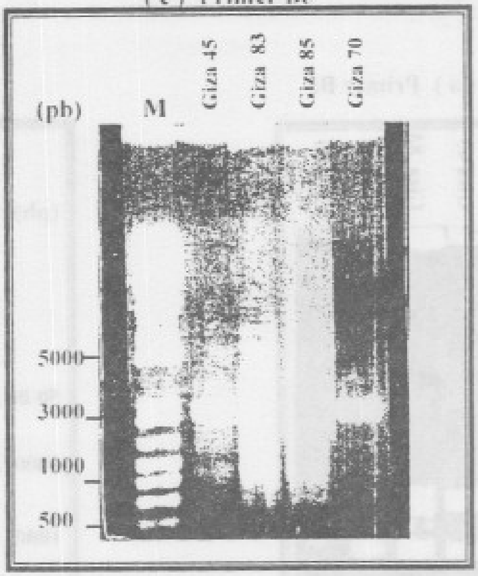

Fig (1) continue

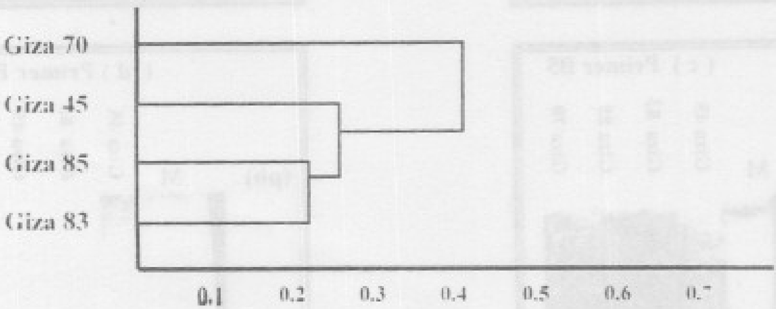

Fig. (2) : Dendrogram demonstrating the genetic distance among the four cotton (*Gossypium barbadense* L.) varieties based on RAPD analysis.

In this regard, Fe-deficiency caused obvious induction of IDI7 new iron-regulated ABC transporter in Fe-deficient barley plants (Yamaguchi *et al.*, 2002), induce 5-10 fold stimulation of ferric reductase activity (Cohen *et al.*, 1998), induce the expression of Fe-transporter gene and specific peptides in barley (Suzuki *et al*, 1997) and led to rapid response in RNA protein levels (Roberts *et al.* 2004). Mn^{+2} deficiency affect the activity of many enzymes (Shenker *et al.*, 2004) and activate the synthesis of specific protein required for their survival. Meanwhile, Zn^{+2} deficiency cause severe depression in plant growth and yield (protein metabolism and gene expresion).

Table (8): Densitometric analysis SDS- PAGE of leaf- total protein of the four cotton varieties (*Gossypium barbadense* L.) under control (ions deficiency) and foliar applications of Zn^{+2}, Mn^{+2} and Fe^{+2} respectively.

Band No.	Mw. KD.	Giza 85				Giza 83				Giza 70				Giza 45			
		Control	Zn^{+2}	Mn^{+2}	Fe^{+2}	Control	Zn^{+2}	Mn^{+2}	Fe^{+2}	Control	Zn^{+2}	Mn^{+2}	Fe^{+2}	Control	Zn^{+2}	Mn^{+2}	Fe^{+2}
1	146	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1
2	145	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
3	134	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	123	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	113	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
6	110	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	100	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	97	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	94	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
10	91	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0
11	88	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	80	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
13	70	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	68	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
15	66	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
16	60	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
17	55	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	52	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
19	50	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	46	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1
21	44	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	43	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
23	34	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	32	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1
25	29	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	28	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
27	27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
28	25	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
29	23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
30	21	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
31	18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

MW : Molecular weight

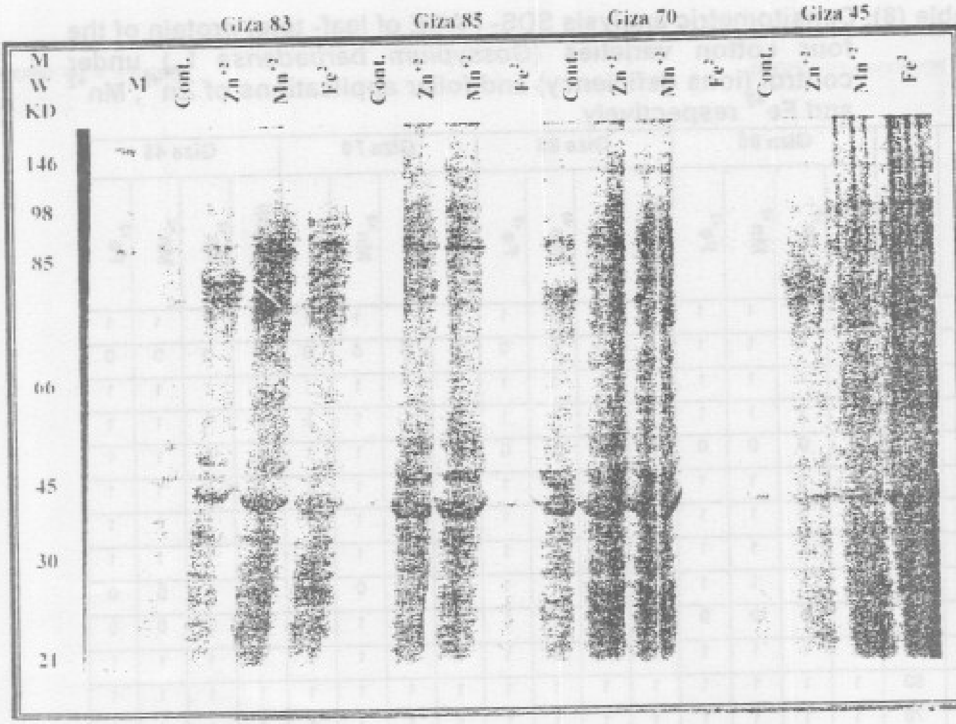

Fig. (3) : SDS – PAGE profiles of leaf total protein of the four cotton varieties (*Gossypium barbadense* L.) under foliar applications of Zn^{+2}, Mn^{+2} and Fe^{+2} .

CONCLUSION

In conclusion, genotype- environment interaction was significant for gene expression, growth, yield and lint percentage and quality of cotton (*Gossypium barbadense* L.). Cotton varieties used in this study are grouped to long stable varieties (Giza 83 and Giza 85) and extra-long stable varieties (giza 45 and Giza 70). The results of their gene expression (protein), growth, yield and lint percentage and quality, in addition to their genetic relationships are in accordance with the earlier studies. Also, the results focusing to great extent to usefulness of RAPD and SDS- protein markers for the evaluation of the genetic relationships between the studied cotton varieties.

In the same time, the usefulness of SDS-protein markers, growth, yield and lint percentage in detecting the micronutrient status in plants. Moreover the results obtained from this study could be used for the selection of the suitable genotypes (varieties) by cotton breeders and producers in the new reclaimed regions as El-Mughara, where salinity and micronutrient deficient predominated. In this regard, long stable variety Giza 83, gave high yield and lint percentage under stress conditions. Whereas Giza 45 characterized by high lint qualities but with low yield. Also, cotton breeders who used marker assisted selection and producers could use cotton varieties clustered or shaied a large proportion of its genetic background with Giza 83 to get good yield under stress conditions.

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تحسين الإنتاجية وصفات التيلة لبعض أصناف القطن المصري تحت ظروف الإجهاد البيئي

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****وحدة الوراثة والسيتولوجى–قسم الأصول الوراثية النباتية–مركز بحوث الصحراء–المطرية–القاهرة – مصر**

أجريت تجربتان حقليتان خلال موسمي (٢٠٠٢ – ٢٠٠٣) بالمزرعة البحثية بمحطة بحوث المغارة شمال سيناء لدراسة تأثير عدد ١٦معاملة هى محصلة التداخل بين أربعة أصناف من القطن المصري وهى (جيزة ٤٥ – جيزة ٧٠ – جيزة ٨٣ – جيزة ٨٥ واربعة معاملات للرش هى ٠.١% سلفات الزنك ،٠.٢٥% سلفات المنجنيز – ٠.٥% كبريتات الحديدوز علاوة على الكنترول (الماء العادى) وذلك على المحصول ومكوناته ، وصفات التيلة لنباتات القطن المصري وبعض الكشافات الوراثية البيوكيميائية تحت ظروف الأراضي الصحراوية وتم استخدام تحليل الاشكال المتعددة للحمض النووى (RAPD) وخمسة بادئات عشوائية لتكبير الحمض النووى بواسطة تفاعل البلمرة التسلسلى مماأدى إلى انتاج ٣١ مكبرمنها ١٥ (٤٨,٤%) عديدة الأشكال وتم انتاج مصفوفة التشابة من نتاج RAPD وكذلك الشكل الشجيرى بواسطة تحليل المجموعات الثنائية للمتوسط الحسابى (UPGMA) وقد أظهرا أن الأصناف طويلة التيلة تصطف بجوار بعضها كذلك الأصناف فائقة طول التيلة كما أن كل صنف له كشافات جزيئية وبيوكيميائية فريدة .

كما أن حزم تحت الوحدات البروتينية المنتجة نتيجة نقص او استخدام العناصر الغذائية ممكن استخدامها وفى الأختيار بمعاونة الكشافات للأصناف العالية الانتاج تحت هذه الظروف .

ومن الممكن ان يستخدم مربوا القطن والمستثمرين نتيجة هذا البحث للحصول على أعلى انتاج واعلى نسبة تيله او انتاج ذى صفات فائقة الجودة وأوضحت النتائج الاتى:

–هناك اختلافات جوهرية بين الأصناف محل الدراسة فى محصول القطن الزهر ومكوناتة خلال الموسمين ٢٠٠٢ – ٢٠٠٣ .

–اظهر الصنف جيزة ٨٣ تفوق ملموسا على بقية الأصناف فى عدد الأفرع الثمرية /النبات – عدد اللوز المتفتح / النبات – وزن اللوزة – وزن القطن الزهر/النبات – وزن القطن الشعر /النبات – معدل الحليج وكذلك محصول القطن الزهر للفدان خلال الموسمين .

–تفوق الصنف جيزة ٤٥ بالنسبة لصفة طول النبات بينما حقق الصنف جيزة ٨٥ افضل زيادة معنوية فى صفة وزن ١٠٠بذرة مقارنة ببقية الأصناف محل الدراسة خلال الموسمين .

– حقق الرش بالعناصر الصغرى استجابة معنوية لجميع صفات المحصول والإنتاجية مقارنا بالكنترول (الرش بالماء العادى) خلال الموسمين ٢٠٠٢ – ٢٠٠٣ .

ادى الرش بكبريتات الزنك الى تحقيق أعلى قيم معنوية فى محصول القطن ومكوناتة مقارنة بالعناصر الأخرى. لكن اظهر الرش بكبريتات الحديدوز ٠،٥% استجابة اقل من الرش بالعناصر الأخرى محل الدراسة بالنسبة للمحصول ومكوناتة خلال الموسمين .

–بالنسبة لتاثير التفاعل بين الأصناف ونظم الرش المختلفة أظهرت فروق معنوية متباينة للمحصول ومكوناته خلال الموسمين .

–حقق التفاعل بين الصنف جيزة ٨٣ مع الرش بكبريتات الزنك ٠.١% زيادة معنوية مع معظم صفات المحصول والإنتاجية . كذلك سجل التفاعل بين الصنف جيزة ٧٠ مع الرش بكبريتات الزنك ٠.١% المرتبة الثانية.

– أظهرت الدراسة اختلافات بين الأصناف بالنسبة لصفات جودة التيلة حيث تفوقت الأصناف فائقة الطول على الأصناف الطويلة فى صفات طول ومتانة ونعومة التيلة

–أدى الرش بالعناصر الصغرى الى تحسين ملحوظ فى صفات التيلة للأصناف طويلة التيلة وكذلك فائقة الطول .

من هذه الدراسة يتضح أن انسب الأصناف المصرية للزراعة في شمال سيناء تحت ظروف الأراضي الرملية والمتأثرة بالملوحة هو الصنف جيزة ٨٣ من الأصناف.