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EVALUATION OF SOME GENOTYPES IN COTTON UNDER STRESS OF LONGEVITY OF THE PERIODS OF IRRIGATION.

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ABSTRACT

water irrigation is one of the important factors for cotton cultivation, growth and production in various cotton growing countries, particularly in Egypt at the present time. To identify water stress tolerant for genotypes, it is vital to understand their genetic variation and its performance under water stress conditions. In the present work, some cotton genotypes belong to (*Gossypium barbadense*, L.) were used to apply two cycles of direct selection to improving productivity, as well as, acceptable fiber properties. The two cycles included two crosses i.e., the first cross (Giza 69 X Pima S 6) and the second cross (Giza 69 X Giza 88) which were evaluated under different water irrigation stress conditions. The control treatment conventional irrigation (C) was the normal irrigation every 15 days interval. The first stress water irrigation treatment (S_1), was the irrigation every 30 days interval and the second stress water irrigation treatment (S_2), was the irrigation every 45 days interval. At maturity, data were recorded on yield and its components, and fiber properties were measured at Fiber Technology Department in Cotton Research Institute (C.R.I.), Agricultural Research Center (A.R.C.).

The results showed reduction in the means of all studied characters under (S_2) condition, i.e., yield components and fiber properties for all the genotypes and their generations. The genotypes exhibited an increase in the mean performances under the control treatment (C) condition for most studied traits in the generations and also treatment (S_1) condition, respectively, due to efficiency of two cycles of direct selection under condition of water irrigation stress. Yield components and fiber properties traits for F_3, F_4 and F_5 generations under control treatment had best and high values versus water stress conditions. The high and the best values were detected for well-watered control treatment conventional irrigation (C) in all studied characters and in the generations, while low and poor values were only detected for treatment (S_2) for all studied characters and in the generations.

This study showed that some yield traits were regulated genetically and environmentally through tested cotton genotypes under water irrigation stress conditions. It was concluded that these yield traits would be used as indicator for screening cotton germplasm for different water irrigation stress conditions as well as for evolving high yielding water stress tolerant genotypes of cotton crop. These findings are useful in breeding programs for identifying and selecting genotypes involved on water stress tolerance in cotton. However, susceptibility index for water irrigation stress were high in some families for most yield characters when compared with most fiber properties, because the fiber properties were largely controlled by genetic variation and influenced by environment conditions in the two populations (Giza 69 X Pima S 6) and (Giza 69 X Giza 88). These families are useful for the breeder may utilize such families in breeding programs aiming to improve yield and fiber characters under water irrigation stress conditions.

Comparing mean performance of F_3 with those of F_4 and F_5 generations revealed increase in mean values for all characters with advanced generations from F_3 to F_4, indicating an accumulation of favorable alleles. F_4 generation showed high G.C.V.% and P.C.V.% values than those of the succeeding generation for all characters. The closer magnitude of G.C.V.% and P.C.V.% in F_5 generation indicated

that genetic had played greater role rather than environment for most characters. The G.C.V.% and P.C.V.% were high in both F_3 and F_4 generations as compared with F_5 generation due to high genetic variance and environmental variance in F_3 and F_4 generations, due to high genetic variance relative to environmental variance and low of genetic differences in F_5 from the rest of previous generations and to increase the homozygosity. The predicted advances were high for all studied characters in F_4 generation compare with F_5 generation, while the predicted advance in F_3 generation at under control treatment had higher values for all studied characters.
Key words: Cotton-Water irrigation stress –Tolerance- Correlation-Susceptibility.

INTRODUCTION

Irrigation stress condition is a complex phenomenon affecting the growth and productivity of cotton plant. Many studies showed that water stress decreased seed cotton yield and its components, due to decreasing of flowers number and bolls retention. The controlled effects of water stress would be minimized by the development of water stresses tolerant cotton cultivars. However, there are limited researches on this aspect due to complex nature of water stress tolerant mechanisms.

Although, cotton is considered to be a tolerant crop for water irrigation stress, its susceptibility varies greatly differ among genotypes (Gorham (1996) and Naidu *et al.* (1998)). Water stress affects the cotton plant growth by limiting yield and inferior lint quality, suggesting the development of water stress tolerant cultivars to get economic yield in water deficient areas. For successful breeding of tolerant cotton cultivars to water stress through conventional approach, basic information about the breeding material must be available to the breeders. First, there must be significant variability in genotypic responses to water stress and secondly, this variation must be genetically controlled. Thus, an understanding of the knowledge of these two components about the breeding material under consideration is necessary (Mitra (2001). Previous studies on water stress tolerance provided sufficient evidence on the occurrence of variation within the *G. hirsutum* (Quisenberry *et al.* (1982), Pereira *et al.* (1998), Basal *et al.* (2005) and Kar *et al.* (2005).

Increasing deficiency of irrigation water is a major threat to sustainable production of cotton (*Gossypium barbadense*, L.) in Egypt. Identifying selection and breeding contributing to water stress tolerance would help developing cotton cultivars suitable for water-limited regions through selection.

Cotton is the most important natural fiber crop in the world. In any case of whether it is irrigated or not, cotton is predominatingly risky to water stress, which adversely affects both yield and fiber properties (Pettigrew (2004). Water stress induced by soil and/or atmospheric water deficiency, affect the most important environmental constraint to plant existence, growth and crop productivity (Boyer (1982). With increasing water stress and population growth, water is expected to become even scarcer in the near future (Chaves *et al.* (2003). Developing water stress resistant crop plants is vital to meet the increased demand of agricultural products and an anticipated environmental shift towards greater aridity (Parry *et al.* (2005).

This solution, however requires comprehensive understanding of plant adaptive mechanisms and responses to water stress for their yield components and fiber properties.

Cotton is originated from wild plants adapted to semi-arid, subtropical environments, however intensive selection has narrowed the genetic variability for water stress tolerance (Rosenow *et al.* 1983), which made it difficult to further improvement of yield potential. To use the existing variability for water stress conditions. Tolerance in cotton, low heritability of yield under stress, length of required-time for improvement program and inherent variation in the field are the limitations of conventional breeding approaches. However, because of a general lack of the genetic studies on water stress tolerance, very little is known about the genetic mechanism controlling variation in water stress tolerance in *G. hirsutum*. Only few studies revealed that water stress tolerance in cotton is under genetic control (Liu *et al.* (1998). Ullah *et al.* (2008) found that the water stress susceptibility index (D.S.I.) ranged from 0.46 to 1.72. in eighteen genotypes which showed tolerance having (D.S.I.) value less than one, whereas 14 were found susceptible with (D.S.I.) values greater than one. Among the high yielding genotypes such as, RH- 510, CIM-473 and CIM-1100 were found to be relatively tolerant to water stress (W_1 regime). Whereas, BH-160, FH-2000, MNH-147 and FH-901 had relatively higher water stress susceptibility indices indicating their susceptibility to water-deficit stress. Karademir *et al.* (2011) found that significant differences were observed among genotypes and water treatments for seed cotton yield, lint yield, ginning percentage and all fiber quality properties except fiber uniformity. Yield differences among genotypes under water stress and non-stress conditions were higher during the first season.

Sarwar *et al.* (2012) attained that for number of bolls per plant, two parameters [md] in cross-1 and four parameters [mdjl] model in cross-2 appeared to be adequate under normal conditions. Under water stress, 5 parameters [mdhij] model in cross-1 and 3 parameter [mdh] model in cross-2 showed best fitness of the observed to the expected generation means for the trait, attained that boll weight under normal conditions 4 parameter [mdhi] model showed its adequacy to the data set for boll weight in both the crosses, whereas under water stress conditions, 4 parameter [mdhi] in cross-1 and 5 parameter [mdhij] model in cross-2 appeared adequate. Both the crosses behaved almost consistent over the stress regimes with positive values of all the parameters involved in the inheritance of boll weight. At Sakha, Turkey (2012) found that 24 genotypes showed water stress tolerance (D.S.I. less than one) in comparison with 25 genotypes at Nubaria. Meanwhile, 23 genotypes at Sakha showed tolerance (D.S.I. value greater than one) in comparison with 22 genotypes at Nubaria. Significant negative association of D.S.I. with seed cotton yield, lint cotton yield, boll weight, seed index and harvest index in two locations and for number of fruiting branches and plant height at Nubaria suggested that the D.S.I. would be a useful prediction of water stress tolerance in cotton. Moreover, non-significant correlation of D.S.I. with ginning outturn, also found that Significant positive correlation of GMY was found with seed cotton yield, lint cotton yield and harvest index in both locations under (W_2) and boll weight, number of fruiting branches/plant and plant height were also significantly associated with GMY at Nubaria under W_2 condition, however the level of these association was not significant at Sakha.

Iqbal *et al.* (2013) indicated that considerable efforts have been made to know the water stress tolerant mechanisms and figure out the traits related to water stress tolerance. The integration of conventional breeding with genetic and genomic tools such as quantitative trait loci (Q.T.L.), micro arrays and transgenic offer new opportunities for improving water stress resistance in cotton and approaches of cotton for water stress tolerance. Riaz *et al.* (2013) studied genotypic variability under water stress in some advanced lines of cotton (*Gossypium hirsutum*, L.). They found that higher broad sense heritability estimates were found for all traits studied. Maximum broad sense heritability coupled with high genetic advance, suggested a potential for genetic improvement through breeding and selection. The correlation coefficients among traits were positively and significantly correlated; thus they could be selected simultaneously as water stress tolerance selection indexes owing to the absence of undesired relationships. Zare *et al.* (2014) found that all the studied traits except number of nodes/plant and number of branches/plant, were influenced by water stress condition. Seed cotton yield was reduced by water stress (47.03%) that was probably due to decrease number of bolls/plant. In the study the studied varieties were differed in their responses to water stress. Therefore, it was possible to discriminate among these varieties on the basis of these parameters and there was a clear-cut distinction between varieties for tolerance and susceptibility to water stress. Abd El- Hafez *et al.* (2003 - a), AL-Ameer (2004) and Ramdan *et al.* (2014) showed a decrease in phenotypic coefficients of variation from F_2 to F_4 generations and from S_0 to S_2 generations for all characters. However, genotypic coefficients of variation would give the best indication of the amount of genetic variance to be expected from selection.

The objectives of this study were to estimate the relationship between yield components and some fiber properties in the three generations to determine the expected advance under three water irrigation stress conditions, using with well watered, control treatment (C), the normal irrigation every 15 days interval, treatment (S_1), was the irrigation every 30 days interval and treatment (S_2), was the irrigation every 45 days interval in the two cotton populations (Giza 69 X Pima S 6) and (Giza 69 X Giza 88). Selection of high families may be utilized in breeding programs aiming to improve yield and fiber characters under water irrigation stress conditions. Also, the purpose of this study was to estimate some constants, important genetic parameters, the improvement by the selection under water irrigation stress conditions and get the genetic germplasm of high productivity to overcome the problem of water irrigation stress conditions with the improvement of some economic traits in cotton.

MATERIALS AND METHODS

The present study was carried out at Sakha Agriculture Research Station during 2011, 2012 and 2013 growing seasons. Three successful generations i.e. F_3 , F_4 and F_5 of the two crosses Giza 69 x Pima S6 and Giza 69 x Giza 88 were used in this study under water irrigation stress conditions, 1- control treatment conventional irrigation (C), according to recommendations at Sakha Experimental Farm which applied the normal irrigation every 15 days interval, 2- the first limited water irrigation stress treatment (S_1), was the irrigation every 30 days interval and 3- the second limited water irrigation stress treatment (S_2), was the irrigation every 45 days interval. In the first season of 2011 F_3 generation consisted of 70 progenies and the two original parents for the first cross Giza 69 x Pima S6, while 65 progenies and the two original parents for the second cross Giza 69 x Giza 88. All these materials were chosen because they gave the best, high values and surpassed studied traits in F_2 generation under different conditions. Each progeny consisted of 30 plants were grown in three replicates ten plants for each replicate, ridges 4.5 meters long and 0.70 meter, each ridge contained 15 hills wide at 30 cms apart and two plants / hill was left at thinning time. Experimental plot was a single row as carried in 2011 season. At the end of season selfed as well as open pollinated bolls / plant were picked up separately and the total seed cotton yield / plant by grams (S.C.Y./P.gm.) was ginned to obtain lint cotton yield / plant by grams (L.C.Y./P.gm.) lint percentage % (L.P.%), seed index by grams (S.I.gm.) and lint index by grams (L.I. gm.).

The superior plants were selected from the two crosses on the basis of the best values of the above characters were determined under three longevity of the periods of irrigation stress well watered conventional treatment (C), the first limited water irrigation stress treatment (S_1) and the second limited water irrigation stress treatment (S_2) conditions.

In 2012 season selected progenies from the two crosses were evaluated including 55 progenies and the two original parents from the first cross Giza 69 x Pima S6, also including 45 progenies and the two original parents from the second cross Giza 69 x Giza 88, were grown in three replicates ten plants for each replicate as the previous generation F_3 ridges 4.5 meters long and 0.70 meter, each ridge contained 15 hills wide at 30 cms apart and two plants / hill was left at thinning time under three water irrigation regimes stress conditions, well watered conventional treatment (C), the first limited water irrigation stress treatment (S_1) and the second limited water irrigation stress treatment (S_2) conditions.

In 2013 season the selected families were evaluated as, 20 and 15 families from F_4 families generation with the original parents from the first cross and the second cross respectively, were grown in a randomized complete blocks design with three replicates. The F_5 generation contain 20 families for the first cross Giza 69 x Pima S6 and 15 families for the second cross Giza 69 x Giza 88, the observations were recorded on 10 plants that were ten guarded F_5 plants per plot randomly selected. A random sample of ten bolls was picked from each plot at harvest time used for determining average boll weight in grams. The remaining plant were picked to determine seed cotton yield/plant in grams, as well as to determine lint cotton yield per plant in grams, lint percentage %, seed index in grams and lint index in grams under three water irrigation stress regimes. The selected families with the original parents from the two populations were grown in ridges 4.5 meters long and 0.70 meter, each ridge contained 15 hills wide at 30 cms apart and two plants / hill was left at thinning time a randomized complete block design with three replicates. Experimental lay out was same as carried out in 2012.

The responses of 20 families from the first population and 15 families from the second population were examined under water irrigation stresses.

In all field trials ordinary agricultural practices were done according to recommendations in Sakha Experimental Farm.

The studied characters were:

Yield components traits

1- Boll weight (B.W.) in grams.
2- Seed cotton yield/plant (S.C.Y./P.) in grams.
3- Lint cotton yield/plant (L.C.Y./P.) in grams.
4- Lint percentage % (L.P.%).
5- Seed index (S.I.) in grams.
6- Lint index (L.I.) in grams.

Fiber properties

7- Fiber length at 2.5 %. (F.L.) m.m.
8- Fiber fineness (F.F.).
9- Fiber strength (F.S.).
10- Uniformity ratio % (U.R.%).
11- Brightness (R.D. %).
12- Yellowness (+ b).

Statistical , genetic analysis and genetic parameters.

Means, ranges, genotypic coefficient of variability (G.C.V. %) phenotypic coefficient of variability (P.C.V. %), heritability in broad sense (H^2_b %) and expected genetic advance (ΔG) were calculated for each character.

To detect significance of means differences were calculated by the least significant difference values (L.S.D.) at 0.05 and 0.01 levels of probability according to the following equation, which was calculated as suggested by Steel and Torrie (1980), using the following formula:

$$L.S.D.(0.05) = t_{0.05,Edf} \cdot \sqrt{\frac{2\ E.M.S.\ error}{r}}$$

$$L.S.D.(0.01) = t_{0.01,Edf} \cdot \sqrt{\frac{2\ E.M.S.\ error}{r}}$$

Where: E.M.S.= the error mean squares ; r = the number of replications.

The combined analysis

$$L.S.D.(0.05) = t_{0.05,Edf} \cdot \sqrt{\frac{2\ E.M.S.\ error}{r \times t}}$$

$$L.S.D.(0.01) = t_{0.01,Edf} \cdot \sqrt{\frac{2\ E.M.S.\ error}{r \times t}}$$

Where: E.M.S.= the error mean squares ; r = the number of replications and t = the number of treatments.

Phenotypic and genotypic variances

The variance components from the statistical analysis of a randomized complete block design with three replications in F_3, F_4 and F_5 generations, the combined analysis over the three treatments were computed based on the test of the homogeneity of error as described by Bartlett (1937) and the form of the analysis of variance and the expectation mean squares for the combined analysis of variance over the treatments are shown in Table 1 as according to Cochran and Cox (1957), also these were used to obtain estimates for the phenotypic and genotypic variances.

Table 1. Combined analysis of variance and expectation mean squares over treatments.

S.O.V.	d.f.	Mean squares	Expectation mean squares
Replications	(r-1)		
Treatments	(t-1)		
Genotypes	(g-1)	M_3	$\sigma^2e + r\,\sigma^2gt + rt\,\sigma^2g$
Genotypes X Treatments	(g-1)(t-1)	M_2	$\sigma^2e + r\,\sigma^2gt$
Error	t(g-1)(r-1)	M_1	σ^2e

Where: r, t and g : are the number of replications, treatments and genotypes, respectively. σ^2_e, σ^2_g and σ^2_{gt} : are error variance, genotypic variance and genotypes by treatments variance, respectively.

The phenotypic variance (σ^2_{ph}), genotypic variance (σ^2_g) and environmental variance (σ^2_e) between plot components in the combined analysis were calculated according to the following equation by Miller *et al.* (1958):

$$\sigma^2_g = \frac{M_3 - M_2}{r \times t}$$

$$\sigma^2_e = M_1$$

$$\sigma^2_{gt} = \frac{M_2 - M_1}{r}$$

$$\sigma^2_g = \sigma^2_g$$

$$\sigma^2_{ph} = \sigma^2_g + \sigma^2_e + \sigma^2_{gt}$$

Where: M = the mean squares ; r = the number of replications and t = the number of treatments

Coefficients of variability

The phenotypic and genotypic coefficients of variation were estimated using the formula developed by Burton (1952):

Phenotypic coefficient of variation (P.C.V.) $= (\sigma_{ph} / \bar{X}) \times 100$

Genotypic coefficient of variation (G.C.V.) $= (\sigma_g / \bar{X}) \times 100$

Estimates of heritability:

Estimates of heritability were determined according to the following equation by Allard (1960):

$$\text{Heritability in broad sense } (H^2_b\ \%) = \frac{\sigma^2_g}{\sigma^2_{ph}} \times 100$$

Where: σ^2_g = the genotypic variance of the generation.
σ^2_{ph} = the phenotypic variance of the generation.

Expected genetic gain under selection:

The expected genetic gain (G_s) was measured according to Johnson *et al.* (1955) and Allard (1960) as follows:

$$G_s = K \cdot \sigma ph \cdot H^2_b$$

Where: G_s = expected genetic gain.
K = selection differential and its value equal to 2.06.
σ ph = phenotypic standard deviation.
H^2_b = heritability value in broad sense.

The expected genetic advance (ΔG) represented as a percentage of lines mean for the trait (Grand mean) was calculated according to Miller *et al.* (1958).

$$(\Delta G) = \frac{G_s}{\bar{X}} \times 100$$

where $\bar{X}$ = lines or families mean for the trait (Grand mean).

Correlation coefficient:

Correlation among the three generations F_3 , F_4 and F_5 for some yield and some fiber studied characters were calculated.

Susceptibility index (S.I.):

The susceptibility index (S.I.) for some yield component characters of cotton and some fiber properties were calculated for families of F_5 generation according to the following formula by Dwiviedi *et al.* (1990) as follows:

$$S.I. = \frac{\overline{X} \text{ Family at } S_2}{\overline{X} \text{ Family at } C} \times 100$$

where $\overline{X}$= Family mean value for the character (Grand mean)in F_5 generation.

S_2 = The second limited water irrigation stress treatment (S_2), was the irrigation every 45 days interval.

C = Well watered conventional treatment (C) according to recommendations at Sakha Experimental Farm was the irrigation every 15 days interval.

RESULTS AND DISCUSSION

All the analysis of variance revealed significant differences among the genetic materials for all studied characters in the single in the F_3, F_4 and F_5 generations and the combined analysis, as well as under irrigation stresses these previous results already had been reported by Karademir *et al.* (2011) and Ramdan *et al.* (2014).

Data in Tables 2 and 3 showed that both the crosses gave mean performances of the values of the F_4 generation were higher in all yield traits and fiber uniformity ratio % under water irrigation stress conditions (C, S_1 and S_2) compared with the generations (F_3 and F_5) special at the conventional irrigation treatment (C). Mean performances of the values of the F_5 generation were low and less in some yield characters i.e., boll weight, seed cotton yield/plant, lint cotton yield / plant, seed index and lint index, where the values were higher and better in most of the studied fiber properties except fiber uniformity ratio % under water stress conditions (C, S_1 and S_2) compared with the rest other generations special at the conventional irrigation treatment (C).

In Tables 4 and 5 the results of the two crosses elucidated that values of the two treatments (conventional irrigation treatment (C) and (S_1)) were the best and higher treatments in F_5 generation for all studied yield traits and most fiber quality properties in most families in the two crosses. Similar results already have been reported by Ullah *et al.* (2008), Karademir *et al.* (2011), Turkey (2012) and Ramdan *et al.* (2014).

In Table 6 the first population (Giza 69 X Pima S 6) showed that the families number 1,2,4,5,6,10,11,,12,13,15,17 gave the best values in F_5 generation for most yield traits and most fiber quality properties, where in Table 7 the second population (Giza 69 X Giza 88) showed that the families number 1,5,6,7,9,10,12,13,14 gave the best values in F_5 generation for most yield traits and most fiber quality properties. This confirms the previously published work of Turkey (2012) and Zare *et al.* (2014).

Table 2.

Table 3.

Table 4.

Table 4. Cont.

Table 5.

Table 5. Cont.

Table 6.

Table7

All previous results were due to the efficiency of the two cycles of direct selection under water irrigation stress conditions.

In Table 8, the results showed that expected genetic advance (∆G) for most yield characters and most fiber properties in the first population was high under the two treatments: (C) and (S_1). This was also true for F_3, F_4 and F_5. Although, the expected genetic advances (∆G) in F_3 and F_4 were higher than in the F_5. This would be due to the lack of genetic differences in the F_5 from the rest of generations and to the increase in genetic homozygosity.

Table 8. Genotypic, Phenotypic coefficients of variability, heritability in broad sense (H^2_b%) and expected genetic gain (∆G) for all the studied characters in each treatment in the first population (Giza 69 X Pima S 6) in the three generations.

Characters	Treatments	F_3 generation				F_4 generation				F_5 generation			
		G.C.V.	P.C.V.	H^2_b%	∆G	G.C.V.	P.C.V.	H^2_b%	∆G	G.C.V.	P.C.V.	H^2_b%	∆G
Yield and yield components													
B . W . gm .	Control	4.84	5.44	79.12	8.87	4.18	4.90	72.52	7.33	1.72	2.65	42.32	2.31
	Stress 1	4.26	5.98	50.80	6.26	4.58	5.11	80.28	8.45	3.09	3.70	70.00	5.33
	Stress 2	4.56	5.46	69.80	7.85	4.66	5.29	77.68	8.47	3.97	4.35	83.33	7.47
S.C.Y./P gm.	Control	17.73	19.76	80.55	32.79	20.29	21.11	92.39	40.17	7.80	8.97	75.53	13.96
	Stress 1	24.23	26.84	81.50	45.06	21.89	22.93	91.13	43.05	7.47	9.57	60.81	11.99
	Stress 2	17.63	19.37	79.39	38.22	21.19	22.55	88.35	41.04	7.37	8.57	60.40	11.57
L.C.Y./P gm.	Control	18.00	20.16	79.77	33.12	21.13	22.04	91.95	41.74	8.18	9.31	77.29	14.82
	Stress 1	26.23	28.66	83.78	49.46	23.16	24.23	91.37	45.61	7.39	9.66	58.48	11.64
	Stress 2	21.02	23.65	78.98	38.48	21.17	22.62	87.54	40.80	9.06	11.33	63.90	14.91
L.P.%	Control	1.91	2.19	75.74	3.42	2.08	2.47	71.12	3.61	1.08	1.23	76.28	1.94
	Stress 1	3.06	3.28	87.01	5.89	1.71	1.94	77.34	3.09	1.12	1.26	79.08	2.05
	Stress 2	1.82	2.12	73.73	3.22	1.94	2.27	73.51	3.43	1.03	1.18	76.51	1.86
S.I. gm.	Control	4.42	4.47	97.79	9.00	4.45	4.58	94.45	8.91	4.57	4.74	92.70	9.06
	Stress 1	4.30	4.34	98.03	8.77	4.57	4.68	95.21	9.18	4.07	4.22	93.18	8.09
	Stress 2	4.45	4.52	97.00	9.03	4.71	4.82	95.32	9.47	5.17	5.27	96.07	10.43
L.I. gm.	Control	5.52	5.83	89.49	10.75	5.45	6.00	82.43	10.19	5.03	5.25	91.73	9.92
	Stress 1	7.12	7.38	92.96	14.13	5.16	5.50	88.03	9.98	3.81	4.10	86.43	7.30
	Stress 2	6.04	6.31	91.38	11.88	4.49	5.05	79.05	8.22	5.27	5.44	93.85	10.52
Fiber properties													
F.L.	Control	5.74	5.95	93.13	11.41	4.15	4.49	85.43	7.89	0.95	1.11	72.77	1.67
	Stress 1	3.70	4.01	85.31	7.05	2.95	3.41	74.77	5.26	0.64	0.95	46.03	0.90
	Stress 2	1.30	2.01	42.01	1.74	2.17	2.64	67.55	3.68	0.68	1.00	45.79	0.94
F.F.	Control	8.66	8.93	94.22	17.32	6.90	7.25	90.64	13.53	2.11	2.45	74.43	3.75
	Stress 1	5.64	6.09	85.53	10.74	5.54	6.60	70.41	9.58	1.32	1.91	47.32	1.86
	Stress 2	2.57	3.75	46.91	3.62	4.38	5.08	74.24	7.78	2.77	3.08	80.90	5.13
F.S.	Control	4.70	4.85	93.97	9.39	4.12	4.27	93.03	8.19	1.39	1.63	73.40	2.46
	Stress 1	4.01	4.11	95.13	8.06	4.48	4.58	95.42	9.01	1.38	1.46	89.78	2.70
	Stress 2	4.38	4.47	95.83	8.83	4.07	4.21	93.31	8.10	1.28	1.49	74.33	2.28
U.R.%	Control	1.50	1.64	84.35	2.85	1.10	1.32	69.21	1.88	0.69	0.74	85.66	1.31
	Stress 1	1.02	1.21	71.78	1.79	1.83	2.01	82.63	3.42	0.50	0.60	71.73	0.88
	Stress 2	0.90	1.16	60.34	1.44	1.35	1.45	87.14	2.60	0.33	0.55	37.40	0.42
R.D. %	Control	2.15	2.26	90.32	4.21	2.71	2.83	91.76	5.35	0.53	0.61	73.56	0.93
	Stress 1	0.76	1.01	56.78	1.18	1.50	1.74	74.03	2.65	0.41	0.52	63.51	0.68
	Stress 2	1.27	1.45	77.13	2.30	2.21	2.34	89.76	4.32	0.28	0.56	25.03	0.29
+ b	Control	3.16	3.33	90.51	6.20	4.55	4.70	93.60	9.07	0.87	1.05	67.84	1.47
	Stress 1	1.37	1.64	69.45	2.35	2.78	3.00	85.62	5.30	0.62	0.93	44.07	0.85
	Stress 2	2.56	2.70	89.94	5.01	4.16	4.27	95.28	8.37	0.54	1.07	25.59	0.56

Where: Control, Stress 1 and Stress 2 Irrigation Stresses: 1- Control treatment Conventional. 2- Stress 1 treatment . 3- Stress 2 treatment .

The values of genetic variation coefficient (G.C.V.%) in F_5 under the three water irrigation stress treatments (C, S_1 and S_2) for seed cotton yield / plant (7.80, 7.47 and 7.37), while for F_3 these values were (17.73, 24.23 and 17.63), respectively. The results achieved from the data of Table 8 showed that most characters had high values for important parameters, such as genotypic coefficient of variability (G.C.V.%), phenotypic coefficient of variability (P.C.V.%), heritability in broad sense (H^2_b%), and expected genetic advanced as a percentage of trait mean (ΔG) compared with the remaining characters. Abd El- Hafez *et al.* (2003 - a) showed a decrease in phenotypic coefficients of variation from F_2 to F_4 generations and from S_0 to S_2 generations for all characters. However, genotypic coefficients of variation would give the best indication of the amount of genetic variance to be expected from selection; these results also were in agreement with those of Rosenow *et al.* (1983), Liu *et al.* (1998), AL-Ameer (2004), Iqbal *et al.* (2013), Riaz *et al.* (2013) and Ramdan *et al.* (2014).

In Table 9, the results indicated that the same trend for expected genetic advance (ΔG) of most yield characters and most fiber properties in the second population was high under (C) and (S_1). The F_4 and F_5 generations were equal but the expected genetic advance (ΔG) in the F_3 and F_4 generations were almost equal to a certain degree. On the other hand, the expected genetic advance (ΔG) was higher than in F_5, due to homozygosity in the F_5 which showed small of genetic variation coefficient (G.C.V.%), where in F_5 generation, under water irrigation stress conditions (C, S_1 and S_2) seed cotton yield / plant showed (16.20, 18.27 and 14.20) compared with the values in F_3 generation which were (8.70, 5.10 and 5.00), respectively. This confirms the previously published work of Rosenow *et al.* (1983), Liu *et al.* (1998), Mitra (2001), Sarwar *et al.* (2012) and Riaz *et al.* (2013).

The decrease values of (ΔG) was due to the decrease in genetic variability in the F_5 generation. Although, values of heritability in broad sense were varied and differed among generations. The large genetic coefficient of variation with heritability values together would give the best indication about the amount of genetic variance to be expected from selection {Burton (1952), Liu *et al.* (1998) and Sarwar *et al.* (2012)}.

Data in Table 10 for the first populations and the second population showed that correlation coefficients among all the studied generations for most traits gave values ranged from highly significant positive or negative to non significant. The F_4 generation had non significant values with most the studied traits except lint percentage % in first populations under C, S_1 and S_2 conditions, which were positive significant (0.729, 0.407 and 0.518, respectively). While, in the second population the values were with most the studied traits except fiber length under water irrigation stress C, S_1 and S_2 conditions, which were positively significant (0.424, 0.718 and 0.798, respectively), indicating that selection in the early generations would be efficient to improve most traits in the following generations due to the relationship between the trait in the F_4 generation for the genetic materials and the rest of the other generations. Such these results already had been reported by Cheng and Zhao (1991), Khan *et al.* (1991) Azhar *et al.* (2004), Turkey (2012), Riaz *et al.* (2013) and EL-Fesheikawy (2014) showed that the seed cotton yield was found to be positively and significantly associated with fiber fineness (0.630), suggest that any improvement in these characters may increase seed cotton yield. The association between yield of seed cotton and fiber fineness was revealed to be negative and highly significant phenotypic correlation, it means that deterioration in these traits may be use as an indicators for decrease seed cotton yield.

Table 9. Genotypic, Phenotypic coefficients of variability, heritability in broad sense (H^2_b%) and expected genetic gain (ΔG) for all the studied characters in each treatment in the second population (Giza 69 X Giza 88) in the three generations.

Characters	Treatments	F_3 generation				F_4 generation				F_5 generation			
		G.C.V.	P.C.V.	H^2_b%	ΔG	G.C.V.	P.C.V.	H^2_b%	ΔG	G.C.V.	P.C.V.	H^2_b%	ΔG
Yield and yield components													
B. W. gm.	Control	5.90	6.24	89.40	11.49	4.07	4.68	75.73	7.30	2.95	3.41	75.20	5.28
	Stress 1	5.93	6.87	74.36	10.53	3.16	3.87	66.89	5.33	2.66	3.16	70.88	4.61
	Stress 2	4.79	5.70	70.61	8.30	5.70	6.13	86.48	10.91	2.91	3.25	79.78	5.35
S.C.Y./P gm.	Control	16.20	17.73	83.47	30.49	11.28	13.68	67.92	19.14	8.70	9.54	83.19	16.35
	Stress 1	18.27	19.67	86.31	34.97	21.85	23.42	87.05	41.99	5.10	7.58	45.16	7.06
	Stress 2	14.20	19.29	54.14	21.52	21.53	23.07	87.12	41.40	5.00	7.21	60.40	8.97
L.C.Y./P gm.	Control	16.45	18.00	83.50	30.97	11.94	14.29	69.84	20.55	8.45	9.37	81.33	15.69
	Stress 1	18.59	20.19	84.76	35.25	21.52	23.09	86.84	41.31	4.45	7.11	39.16	5.74
	Stress 2	13.67	19.03	51.62	20.23	22.35	23.90	87.51	43.08	6.18	7.45	68.78	10.56
L.P.%	Control	2.29	2.57	79.42	4.20	2.20	2.46	80.11	4.06	0.60	0.80	55.93	0.93
	Stress 1	1.95	2.25	74.73	3.47	2.65	2.88	85.08	5.04	0.98	1.13	74.53	1.73
	Stress 2	1.91	2.24	72.80	3.36	1.97	2.27	74.92	3.51	0.90	1.15	61.34	1.45
S.I. gm.	Control	3.42	3.55	93.07	6.81	4.57	4.71	94.25	9.15	4.59	4.79	91.92	9.07
	Stress 1	5.36	5.42	97.95	10.94	4.03	4.16	93.59	8.02	5.30	5.37	97.37	10.77
	Stress 2	3.89	4.01	93.77	7.76	3.87	4.01	93.36	7.71	2.69	2.94	83.64	5.07
L.I. gm.	Control	6.21	6.56	89.62	12.11	4.76	5.14	85.72	9.07	4.03	4.26	89.59	7.86
	Stress 1	8.09	8.34	94.09	16.17	5.26	5.66	86.31	10.06	4.85	4.94	96.43	9.82
	Stress 2	5.81	6.24	86.73	11.15	4.80	5.27	83.17	9.03	2.42	2.87	70.81	4.19
Fiber properties													
F.L.	Control	1.68	2.38	49.80	2.44	2.80	3.31	71.47	4.87	1.41	1.51	86.86	2.73
	Stress 1	1.49	2.24	44.23	2.04	3.00	3.34	80.95	5.56	1.44	1.58	83.19	2.70
	Stress 2	1.48	2.27	42.64	1.99	2.96	3.35	78.20	5.39	1.61	1.79	80.47	2.97
F.F.	Control	1.34	3.31	16.31	1.11	4.22	5.20	65.94	7.06	1.58	1.97	64.13	2.61
	Stress 1	1.62	3.24	25.04	1.67	5.35	5.95	80.97	9.92	1.67	2.10	62.94	2.72
	Stress 2	1.82	3.35	29.44	2.03	4.76	5.50	74.67	8.47	1.99	2.35	71.66	3.46
F.S.	Control	3.23	3.39	90.81	6.34	4.00	4.13	93.81	7.99	1.28	1.43	79.93	2.36
	Stress 1	3.01	3.25	85.91	5.75	2.93	3.38	75.32	5.24	0.92	1.20	58.89	1.45
	Stress 2	3.57	3.72	91.98	7.05	3.55	3.75	89.73	6.93	1.54	1.71	81.38	2.87
U.R.%	Control	0.50	0.89	31.65	0.58	0.95	1.21	61.36	1.53	0.54	0.65	68.16	0.91
	Stress 1	0.77	1.09	50.24	1.13	0.92	1.26	53.13	1.38	0.36	0.46	62.72	0.59
	Stress 2	0.45	0.93	23.79	0.45	1.05	1.33	62.24	1.70	0.63	0.70	78.89	1.14
R.D. %	Control	2.22	2.55	79.11	4.21	1.78	2.06	74.89	3.18	1.44	1.60	81.16	2.67
	Stress 1	2.78	2.95	88.83	5.41	2.24	2.44	84.65	4.25	1.35	1.42	90.11	2.64
	Stress 2	2.01	2.27	77.98	3.65	1.84	2.13	74.18	3.26	2.05	2.16	90.41	4.01
+ b	Control	2.17	2.38	83.53	4.09	3.09	3.40	82.81	5.80	2.14	2.33	84.75	4.06
	Stress 1	5.11	5.24	95.21	10.28	3.92	4.17	88.36	7.59	2.32	2.45	89.87	4.53
	Stress 2	5.47	5.58	96.13	11.05	4.54	4.73	92.37	8.99	3.62	3.70	95.46	7.28

Where: Control, Stress 1 and Stress 2 Irrigation Stresses: 1- Control treatment Conventional. 2- Stress 1 treatment . 3- Stress 2 treatment .

Significant and positive correlation coefficient values were found between pairs of traits and each other and between each two generations. Thus, when selection in the early generations, it means that selection process is efficient to improve the traits in the following generations. The high correlation coefficient values in yield characters were less in the fiber staple length and fiber staple strength, therefore the breeder must to be the application of some selection modified methods such as the recurrent selection and intermitting design selection in order to improve those characters and must to be break this kind of negative correlation.

Although, seed cotton yield/plant trait of correlation coefficient values between generations and each other are not significant and negative, because it is a quantitative trait, which controlled by a large number of genetic factors and influenced by a large environmental conditions and the effect of non-additive variation was high, therefore the focus is to vote on the assessment of later generations to evaluate those selected families of those character, this is with agreement to Liu *et al.* (1998), Turkey (2012) and Riaz *et al.* (2013).

In Tables 11 and 12, Susceptibility index values showed that the lowest values are more affected by water irrigation stress conditions and this means that there is an appropriate growth conditions and lower the values of susceptibility index. The results showed that there are some families excelled in some traits under water irrigation stress conditions and were less affected by the surrounding water stress environmental conditions, they would be used as lines for water irrigation stress tolerant. These results were in agreement with Ullah *et al.* (2008), Turkey (2012), Iqbal *et al.* (2013) and Zare *et al.* (2014).

The results in Tables 11 and 12 indicated that some families showed differential responses effect of water irrigation stress tolerant, where that the families in the first population (1,2,4,5,6,10,11,,12,13,15,17) and (1,5,6,7,9,10,12,13,14) in the second population were high supremacy in water irrigation stress tolerant. While, some families which showed low values compared with the remaining families were more depression for water irrigation stress tolerant. The results presented in Tables 11 and 12 showed that the genotype of some families recorded high values compared with the rest families. These families are useful for the breeder may utilize such families in breeding programs aiming to improve yield and fiber characters under water irrigation stress conditions. This may be of use in water irrigation stress tolerant management. Although, cotton is considered to be a water stress tolerant crop, its susceptibility varies greatly among genotypes, These results were coincident with those reported by Gorham (1996), Naidu *et al.* (1998), Ullah *et al.* (2008), Turkey (2012) and Zare *et al.* (2014).

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تقييم بعض التراكيب الوراثية في القطن تحت إجهاد طول فترات الري.

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إن الغرض من هذه الدراسة هو تقدير بعض الثوابت و المكونات الوراثية الهامة و التحسين بالانتخاب تحت ظروف إجهاد تطويل فترات الري و الحصول على تراكيب وراثية جديدة ذات إنتاجية عالية للتغلب على مشكلة عجز و قلة المياه مع تحسين بعض الصفات الاقتصادية في القطن حيث أن قلة المياه هي عامل مهم و محدد في نمو و إنتاجية القطن في جميع أنحاء العالم وخاصة في مصر في الآونة الأخيرة من هذا العصر.

وقد اشتملت الدراسة الحالية على هجينين هما جيزة 69 X 6 Pima S و جيزة 69 X جيزة 88 وقد أجريت هذه الدراسة في مزرعة محطة البحوث الزراعية بسخا بمحافظه كفر الشيخ بمعهد بحوث القطن– مركز البحوث الزراعية عبر المواسم الزراعية 2011 ، 2012 و 2013 ؛ وذلك لدراسة تـأثير الانتخاب تحت ظروف إجهاد تطويل فترات الري وانتخاب تراكيب وراثية جديدة و تحسين بعض الصفات الاقتصادية في القطن تحت ظروف هذا الإجهاد حيث تمت المعاملة لهذه التراكيب تحت ظروف الري العادية كل 15 يوماً كمقارنة وكنترول ثم ظروف إجهاد طول فترة الري الأولى حيث الري كل 30 يوماً ثم ظروف إجهاد طول فترة الري الثانية حيث الري كل 45 يوماً.

ويمكن تلخيص النتائج المتحصل عليها في النقاط التالية :-

1- مقارنة قيم متوسطات صفات الجيل الرابع مع متوسطات الجيلين الثالث و الخامس أظهرت زيادة و ارتفاع في قيم المتوسطات لكل صفات المحصول المدروسة و صفة نسبة انتظام التيلة في المعاملات الثلاث (الكنترول و إجهاد طول فترة الري الأولى و إجهاد طول فترة الري الثانية) مقارنة ببقية الأجيال الأخرى و خاصة الزيادات و الارتفاعات دائما كانت في معاملة الكنترول ويرجع ذلك للتأثر بالعوامل و الظروف البيئية المحيطة و المؤثرة في زيادة قيم تلك الصفات و ذلك في كلا الهجينين المدروسين. وكذلك كانت قيم المتوسطات لصفات الجيل الخامس مقارنة مع متوسطات الجيلين الثالث و الرابع أظهرت زيادة وارتفاع في قيم المتوسطات لكل صفات التيلة عدا صفة نسبة انتظام التيلة في المعاملات الثلاث (الكنترول و إجهاد طول فترة الري الأولى و إجهاد طول فترة الري الثانية) مقارنة ببقية الأجيال الأخرى و خاصة الزيادات و الارتفاعات دائما كانت في معاملة الكنترول و ذلك في كلا الهجينين المدروسين ويرجع ذلك لأنها صفات

يتحكم فيها التباين الوراثي بشكل كبير حيث تتجمع الأليلات المفيدة و المؤثرة في زيادة قيم مثل هذه الصفات وراثية التوريث .

2- كانت قيم المعاملتين (الكنترول و إجهاد طول فترة الري الأولى) من أفضل و أعلى المعاملات في الجيل الخامس في كل صفات المحصول ومعظم صفات التيلة وفي معظم العائلات في كلا الهجينين الأول و الثاني.

3- العشيرة الأولى Pima S 6 X 69 في الجيل الخامس أعطت بعض العائلات أفضل و أعلى القيم في معظم صفات المحصول و معظم صفات التيلة، بينما العشيرة الثانية جيزة 69 X جيزة 88 في الجيل الخامس أعطت بعض العائلات أفضل و أعلى القيم في معظم صفات المحصول و معظم صفات التيلة.

4- كما أوضحت النتائج في كلتا العشيرتين أن قيم مقدار التحسين الوراثي المتوقع كان مرتفعاً إلي حد ما في معاملة الكنترول و معاملة إجهاد طول فترة الري الأولى في الجيل الثالث في حين تساوي مقدار التحسين الوراثي المتوقع للجيلين الرابع والخامس لمعظم الصفات المدروسة محصول وتيلة ولكن أظهرت النتائج تساوي قيم مقدار التحسين الوراثي المتوقع في الجيلين الثالث والرابع إلي حد ما وكان أعلي عن مثيله في الجيل الخامس كما كان معامل الاختلاف الوراثي والمظهري مرتفعا في الجيلين الثالث و الرابع عن الجيل الخامس. ويرجع ذلك إلي قلة الاختلافات الوراثية في الجيل الخامس لزيادة الأصالة الوراثية واتضح ذلك من قلة معامل الاختلاف الوراثي حيث كان في الجيل الثالث للعشيرة الأولى 17.73, 24.23, 17.63 في حين كان في الجيل الخامس 7.80, 7.47, 7.37 على التوالي ونفس الاتجاه لمعظم الصفات المدروسة و في العشيرة الثانية 16.20, 18.27, 14.20 في حين كان في الجيل الخامس 8.70, 5.10, 5.00 على التوالي ونفس الاتجاه لمعظم الصفات المدروسة وكان التحسين الوراثي كاستجابة مباشرة لتطبيق الانتخاب سجل قيما عالية من التحسين في الجيل الخامس بالمقارنة بالتحسين المقدر في الجيلين الثالث و الرابع ويرجع ذلك إلى زيادة وتأثير التباين الوراثي عن التباين البيئي .وقد تراوحت قيم معامل التوريث في المدى الواسع بين الأجيال و بعضها بين الارتفاع و الانخفاض و كذلك في المعاملات الثلاث.

5- كانت قيم معامل الارتباط الأعلى والمعنوية والموجبة بين الأجيال وبعضها تعني أنه عندما يتم الانتخاب للصفات في الأجيال المبكرة يعني ذلك أن الانتخاب ذو كفاءة في عملية التحسين في تلك الصفات في الأجيال التالية حيث أن الأعلى مثلاً في صفة وزن اللوزة سيكون أعلي في صفة المحصول الزهر والمحصول شعر وهكذا و كذلك فإن الأعلى مثلاً في صفة طول التيلة سيكون أعلى في صفتي متانة التيلة و نسبة انتظام التيلة.

6- كانت قيم معامل الارتباط لصفة المحصول ما بين الأجيال وبعضها غير معنوية وسالبة ذلك لأنها صفة كمية يتحكم فيها عدد كبير من العوامل الوراثية وتأثرها بالبيئة كبير وتأثير التباين السيادي فيها عالي وبالتالي يتم التركيز في الانتخاب علي تقييم الأجيال المتأخرة لتقييم تلك العائلات المنتخبة لتلك الصفة و كذلك كانت قيم معامل الارتباط الأعلى في صفات المحصول أقل في صفة طول التيلة ومتانة التيلة ولذلك يجب على المربي تطبيق بعض طرق الانتخاب المُحورة مثل الـ Recurrent selection و Intermitting design selectionوذلك لتحسين تلك الصفات و كسر مثل هذا النوع من الارتباط السالب و العمل على زيادة التكرارات الجينية المكسور فيها الارتباط السالب بين المحصول و الجودة و ذلك هو المرغوب و المفيد.

7- أوضحت النتائج أن القيم الأقل لمعامل قابلية تأثر الصفات لإجهاد طول فترات الري بالعائلات تعنى أن الصفة أكثر تأثراً بإجهاد طول فترات الري و يرجع ذلك إلى أن هناك ظروف غير ملائمة للنمو و كلما ارتفعت و ازدادت القيم و اتجهت نحو القيمة 100 % كانت أكثر تحملاً لظروف إجهاد طول فترات الري.

8- و قد اتضح من النتائج أن هناك بعض العائلات تفوقت في بعض الصفات تحت ظروف إجهاد طول فترات الري و كانت أقل تأثراً ببيئة إجهاد طول فترات الري المحيطة و هذه يمكن أخذها كسلالات تتحمل إجهاد طول فترات الري.

9- من مكاسب هذه الدراسة و البحث تم الحصول على أفضل العائلات المتفوقة في صفات المحصول وجودة التيلة وتمتاز هذه العائلات بتفوقها عن أفضل الإباء وعليه فانه يمكن استخدام هذه العائلات في برامج التربية لتحسين صفات القطن المصري تحت ظروف إجهاد طول فترات الري.