Response to Selection for Seed Cotton Yield of (Giza 95 x Super Giza 86) Egyptian Cotton Cross under Newly Reclaimed Lands Conditions

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ABSTRACT

Selection for seed cotton yield plant[-1] in a segregating population of cotton of cross Giza 95 x Super Giza 86 was applied under new reclaimed lands conditions for three summer season, 2019, 2020 and 2021 at Mallawy Agriculture Research station, west of El Minia. The wide range of seed cotton yield/plant in the F_2-generation from 16.40 to 186.00 gm. Indicating ability effective selection for seed cotton yield. Entries mean squares of the selection criterion; seed cotton yield and lint yield/plant and number of bolls/plant were high significant in F_4-generation. Estimates higher than 82.71% of heritability for the seed cotton yield, lint yield/plant and branches/plant. Two families; No. 6 and 9 were higher than the better parent Giza 95 and bulk sample in each of seed cotton yield, lint yield/plant and number of bolls /plant in the F_4-generation. Four selected families no. 2, 6, 9 and 20 were showed significant (p≤0.05 or 0.01) increase compared to the bulk in seed cotton yield/plant by 19.26, 50.03, 32.16 and 64.26%, respectively. The seed cotton yield per plant showed strong positive genotypic and phenotypic correlation with each of lint yield per plant by 0.99 and bolls number/plant 0.97 and 0.95, respectively. Moreover, low positive correlation with boll weight, seed index, fiber length and uniformity index, with negative correlation with each of lint percentage, fiber fineness, lint index and fiber strength.

***Keywords*:** selection, segregating population, heritability, genotypic, phenotypic.

INTRODUCTION

Cotton is considered the first fiber crop in the world and it is considered the most important cash crop in Egypt, hence great effort have been devoted to increase the yield capacity and fiber quality through breeding programs, which depends on the knowledge concerning multiple factors such as heterosis, inbreeding depression and the nature of the interactions of genes controlling different characters. Cotton breeding program use hybridization between the desired genotypes and use pedigree method of selection for developing new varieties that possess higher yield and good quality Hybridization followed by pedigree selection was and still the breeding procedure that yielded all Egyptian cotton varieties grown commercially. Most of plant breeders use pedigree selection method to develop cotton varieties.

The information about the degree of association among different traits and different generations (F_2, F_3 and F_4) of cotton is of great importance to plant breeding programs designed to combine the desirable expression of several characters.

Negative correlation between any traits selected may results in a reduction in the rate of improvement for some of the traits in comparison to the improvement that could be attained if the correlations were positive or non-existent. Therefore, the breeder should use some kinds of modified selection procedures to improve the population mean of concerned traits. Similar results are found by Echekwu (2001), Tang et al. (2009) and El-Lawendey and El-Dahan (2012).

The current study aims to determine the efficiency of selection for seed cotton yield plant-1 in a segregation population of cotton under new reclaimed lands conditions.

MATERIALS AND METHODS

The experiment was carried out for three successive seasons; 2019, 2020 and 2021 in sandy soil at Mallawy Agriculture Research station, El Minia.

Table 1. The chemical analysis of the sandy soil.

Items	Value	Range			
p H	7.8	7.00 - 7.50			
E.C.	1.15	1.00-2.00			
Ca Co3 %	4.17	≤ 7.00			
Soluble Cations (meq/L.)			Soluble Anions (meq/L.)		
Ca +2	9.00	0.30	CO3 -2	0.00	-
Mg +2	1.00	3.00	HCO3 -1	10.00	-
Na +	13.00	0.30	Cl	1.40	-
K +	0.12	-	SO4 -2	0.10	-
Macro elements (ppm)			Micro elements (ppm)		
N	10.00	80.00-100.00	Fe	1.57	4.00-6.00
P	0.02	15.00-25.00	Cu	0.62	1.00-1.50
K	91.00	250.00	Zn	0.24	1.20-1.50
			Mn	0.21	1.80-2.00

The basic material was a segregating population in F_2-generation raised from the cross (Giza 95 x Super Giza 86).

Table 2. The pedigree and categories of the two parental cotton varieties

Variety	Pedigree	Category
Giza 95	Giza 83 x (Giza 75 x 5844) x Giza80	Long stable
Super Giza 86	Giza 75 x Giza 80	Long stable

Experiment layout:

In 2019 season, 500 individuals' plants in F_2-generation were grown on March 26th 2019 in spaced plants in rows 60. cm apart and 40 cm within a row between hills. After full emergence three weeks after growing the hills were thinned to one plant per hill. Also, the two parents were grown in separate plot. The recommended cultural practices for cotton production in newly reclaimed lands were adopted throughout the growing seasons.

Data were recorded on 400 plants from each population. At end of the growing season, two pickings were taken on all single plants. Pedigree selection was practiced on the highest 100 yielding plants in cotton seed yield plant[-1] as a selection criterion (25% selection intensity) form each population.

An equal number of from each plant (500 plants) were bulked to give F_3 random bulk sample.

In 2020 season, the 100 families along with the parents and the bulk simple were grown in March 29th 2020. A randomized complete black design of three replications was used. The plot size was one row 4 m. in long, 60 cm. apart and 40 cm. within a row between hills. After full emergence seedlings were thinned to one plant per hill (10 plants/row). At end of the season, the best plant from each of the best 30 families in seed cotton yield plant[-1] was save to give 30 selected plants for the selection criterion (seed cotton yield per plant).

In 2021 season, the thirty selected plants (F_4-generation) were grown on March 24th 2021. The same procedures for the previous season were followed.

The following traits were recorded on individual guarded plants of each plot: Seed cotton yield/plant in gm. (SCY/P), Lint yield/plant in (gm.) (LY/P), Lint percentage (LP) = (lint yield / seed cotton yield per plant) x100, Boll weight in gm. (BW), Number bolls / plant (NB/P), Seed index in gm. (SI) as weight of l00 seeds and Lint index in gm. (LI) as weight of lint cotton in sample (weight of seeds in this sample) x seed index.

The following fiber quality traits were taken on only 100 individual plants selected from F_2-generation in season 2019 because of difficulty take fiber quality traits on the all F_2 plants (500 plants), while in F_3 and F_4, the four fiber quality traits were taken on all selected plants by 100 plants of F_3 and 30 plants of F_3.

1- Fiber fineness (Mic), fineness was expressed as Micron ire value.
2- Fiber strength as Pressley Index (PI) was measured by the H.V.I instrument
3- Fiber length (UHM), the Upper Half Mean length was measured by H.V.I.
4- Uniformity index (UI %) was measured as a ratio between the mean length and the upper half mean length of fibers and is expressed as a percentage.

Statistical procedures:

Data were subjected to proper statistical analysis of RCBD according to Steel and Torri (1980). Analysis of variance and covariance were performed on the studied traits based on the plot mean to estimate heritability, genotypic and phenotypic coefficients variations, phenotypic and genotypic correlations were estimated by the methods outlined by Johnson *et al*. (1955).

Broad sense heritability H.bs was estimated as the ratio of genotypic to phenotypic variances according to Walker (1960).

The phenotypic (pcv%) and genotypic (gcv%) coefficients of variability were estimated according to Burton (1952).

Phenotypic and genotypic correlation coefficients were determined as outlined by Hanson *et al*. (1956).

Estimates of expected genetic advance (ΔG) in F_2-generation according to (Falconer, 1981)

Observed direct selection response for the selected families were determined by following formula given by Steel and Torri (1980) and measured as deviation percentage of family mean from the bulk sample or the better parent.

The significance of observed direct response to selection was using least significant difference LSD as follows: $L.S.D = t . \sqrt{\frac{2\,MSe}{r}}$

RESULTS AND DISCUSSION

Pedigree selection for seed cotton yield per plant was conducted on a segregating cotton population in F_2, F_3 and F_4-generation throughout three growing seasons of 2019, 2020 and 2021. Single trait selection for seed cotton yield was applied.

A- Description of the base population.

Seed cotton yield/plant in the F_2-generation ranged from 16.40 to 186.00 gm. with an overall mean 57.06 gm (Table 3). Indicating wide range of variability and selection for seed cotton yield could be effective. Similar results are found by Shaheen *et al*. (2000), Jin and Zhang (2005), El-Lawendey *et al*. (2008) and El-Okkiah *et al*. (2008).

Table 3. Means, phenotypic variance (δ²ph), heritability in broad sense (H b) and expected genetic advance (ΔG) of the base population for the studied traits in cotton; season 2019.

Items	SCY/P	LCY/P	L %	N.B/P	BW	SI	LI
			Base population				
Mean	57.06	22.16	38.47	30.42	1.87	7.69	4.82
±SE	±1.15	±0.49	±0.12	±0.59	±0.01	±0.02	±0.03
σ² ph	531.54	94.74	6.04	139.63	0.02	0.20	0.29
Kurtosis	4.70	3.99	-0.54	4.46	3.66	1.04	-0.31
Skewness	1.62	1.58	-0.59	1.49	-1.33	-0.15	-0.16
Min.	16.40	6.00	31.36	8.20	1.09	6.00	3.26
Max.	186.00	75.00	42.80	97.89	2.30	9.30	6.35
C.V.%	40.41	43.91	6.39	38.84	7.64	5.78	11.13
H b %	51.31	61.01	79.31	56.12	41.00	49.40	61.84
ΔG	15.04	7.55	2.48	8.43	0.07	0.28	0.42
ΔG/Mean	26.35	34.06	6.44	27.71	3.99	3.63	8.75
			Giza 95				
Mean	69.27	26.37	38.20	35.45	1.99	7.57	4.68
±SE	±4.66	±1.64	±0.37	±2.69	±0.03	±0.11	±0.10
σ²	217.29	27.00	1.38	72.29	0.01	0.11	0.10
Min.	48.50	19.20	36.58	25.30	1.90	6.90	4.40
Max.	92.50	33.90	40.41	48.68	2.20	8.00	5.43
C.V.%	21.28	19.70	3.08	23.99	5.53	4.45	6.69
			Super Giza 86				
Mean	72.63	28.46	39.16	38.20	1.96	7.52	4.85
±SE	±5.48	±2.16	±0.34	±2.24	±0.04	±0.09	±0.11
σ²	300.32	46.87	1.12	50.24	0.02	0.09	0.12
Min.	45.90	17.90	37.30	28.69	1.70	7.10	4.34
Max.	102.80	40.10	40.78	51.40	2.20	8.00	5.44
C.V.%	23.86	24.05	2.71	18.55	6.89	3.90	7.00

Comparing the population mean with the two parental means indicated partial dominate towards to the low yielding parent Giza 95 (69.27 gm.) in which the population mean was (57.06 gm.) (Figure 1). The coefficient of variability in seed cotton yield was 40.41% (Table 3), this value was very high indicating ability for selection seed cotton yield in F_2-generation. Similar results are found by Mahdy *et al*. (2001a), Mahdy *et al*. (2006), Mahdy *et al*. (2007) and Hassaballa *et al*. (2012)

The wide range of variability of the two parents which are determine the environmental variances reduced the genetic variance in F_2-generation of the population. Furthermore, the dominants effect was obvious hence estimates of heritability in broad sense was intermediate by 51.31% (Table 3).

Estimate of heritability in broad sense were high for the most traits and intermediate for boll weight (41.00%) and seed index (49.40%) (Table 3).

Regard lint cotton yield ranged from 6.00 to 75.00 with average 22.16 gm. The population mean showed dominance or over dominance compared to the lowest parent (Giza 95) 26.37 gm.

Mean of seed cotton yield / plant (57.06 gm.), lint cotton yield (22.16 gm) and number of boll per plant (30.42) showed

over dominance towards to the lower parent Giza 95 which gave 69.27 gm., 26.37 gm. and 35.45 for these traits, respectively. Indicating effective selection for these traits. Moreover, mean of seed index 7.69 gm. showed over dominance towards to the higher parent Giza 95 (7.57 gm.) (Table 3).

Lint percentage of (38.47%) showed partial dominance towards to the lower parent Giza 95 (38.20%) while the contrast was observed for lint index.
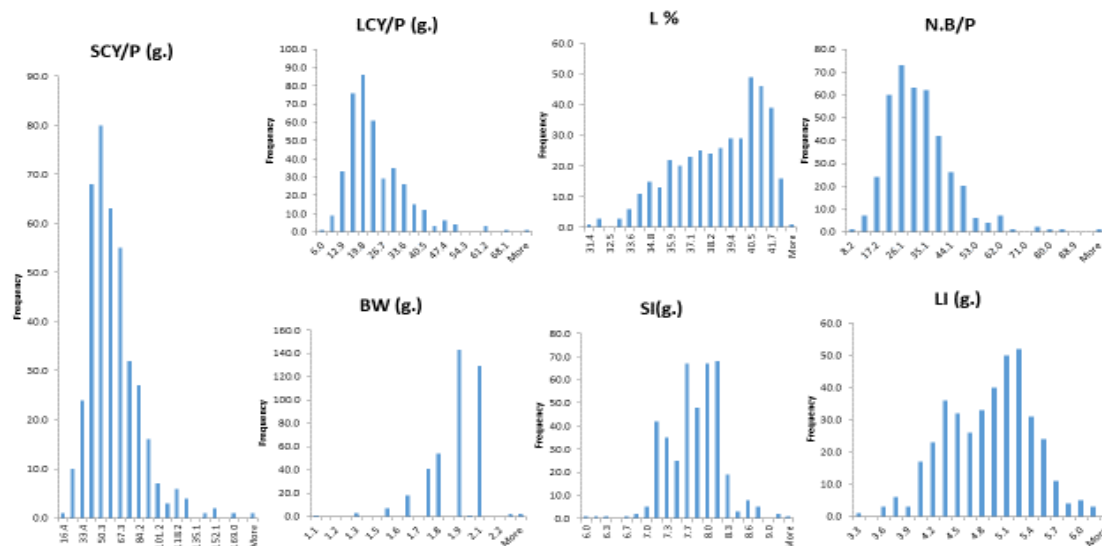
Figure 1. The characteristics of the individual plants in F$_2$-generation for the studied traits.

Simple correlation coefficients among the studied traits in the base population are shown in Table 4.

Seed cotton yield per plant showed positive and significant (p≤0.01) correlation with all studied traits in except seed index where the correlation coefficient was very low negative and insignificant. Indicating that selection for seed cotton yield may resulted in increase in these traits, while may cause decrease seed index.

Correlation coefficients between lint cotton yield with each of L%, NB/P, BW and LI were positive and significant (p≤0.01). Indicating that selection for lint cotton yield resulted in increased lint percentage, number of bolls / plant and lint index.

Table 4. Simple correlation coefficients among traits of the base population in the F$_2$-generation, season 2019.

	SCY/P	LCY/P	L %	N.B/P	BW	SI	LI
SCY/P	-	0.99**	0.38**	0.98**	0.21**	-0.06	0.32**
LCY/P		-	0.49**	0.97**	0.20**	-0.08	0.41**
L %			-	0.37**	0.03	-0.12*	0.85**
N.B/P				-	0.02	-0.05	0.32**
BW					-	-0.07	0.00
SI						-	0.41**
LI							-

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

Lint percentage showed positive and significant (p≤0.01) correlation with each of number of bolls and lint index.

Positive and significant (p≤0.01) correlation was found between number of boll/plant and lint index.

Boll weight showed negative and insignificant correlation with seed index. Positive and significant (p≤0.01) correlation in F$_2$ generation was observed between seed index and lint index. Echekwu (2001), Tang et al. (2009) and El-Lawendey and El-Dahan (2012).

B- Evaluation of pedigree selection for seed cotton yield in F$_3$ generation, season 2020.

1- Means, variance and heritability estimates

Mean squares of the 100 selected families for seed cotton yield / plant and the other correlated traits are shown in Table 5.

Mean squares of the entire studied trait were significant (p≤0.01) except for lint percentage and boll weight. Indicating the presence of variability in the selection criterion, seed cotton yield per plant. Similar results are found by Abdel-Zaher *et al.* (2007), Khan et al. (2009), Tang *et al.* (2009) and Soomro *et al.* (2010)

Seed cotton yield/plant ranged from 46.97 to 160.47 with average 86.06 gm. and showed over dominance lower than the low yielding parent Giza 95 (117.30 gm.) the same trend was found with trait lint yield per plant.

Complete dominance was found for traits lint percentage, boll weight and fiber strength. Where the dominance was towards to the lower parent Giza 95 (1.83 gm.) and mean of population (1.85 gm.) of boll weight moreover, the dominance was towards to the higher parent in the two others traits L% and PI.

Lint yield per plant was showed over dominance to lower parent Giza 95. Lint index and fiber length were showed additive gene action or on dominance because the mean of population was nearly equal to the mid parents.

Lint percentage, uniformity index was showed the complete dominance towards to the higher parent Super Giza 86. The rest traits were showed over dominance towards to the lower parent Super Giza 86 for traits NB/P, SI, MIC mc and uniformity index.

Estimate of genotypic and phenotypic coefficients of variability were high for seed cotton yield per plant by 22.52 and 22.98 %, respectively (Table 5). Also, g.c.v and p.c.v values were high for LY/P and NB/P by (27.95 and 83.63%) and (22.09 and 22.93%), respectively (Table 5).

The close estimates of g . c. v and p. c. v resulted in high estimates of heritability in broad sense of SCY/P, LY/P and NB/P by 96.00%, 94.29% and 92.77%, respectively. These high values of coefficients of variability and heritability

resulted in high estimates of the expected genetic advance of F_3 mean by 47.66%, 48.13% and 45.95% for traits SCY/P, LY/P and NB/P, respectively. The same trend was found for trait fiber fineness. Similar results are found by Tang et al. (2009) and Hassaballa et al. (2012).

The g. c. v and p. c. v values for the rest traits were low ranged from (1.06 and 1.11%) of UI% to (5.43% and 8.32 %) of LI, respectively (Table 5).

Table 5. Mean squares of the studied traits for the 100 families in F3-generation, family mean, the parents and the bulk, phenotypic (pcv) and genotypic (gcv) coefficients of variability, expected genetic advance (ΔG) and heritability in broad sense (H b).

Items	df	SCY/P	LY/P	LP/%	NB/P	BW	SI/g
MS Reps	2	150.37	37.98	16.77	608.13	0.7	8.3
MS Entries	102	1219.75**	193.08**	8.94	351.46**	0.03	0.32**
MS Error	204	48.72	13.19	8.85	26.86	0.02	0.18
Mean		86.06	33.15	38.54	46.86	1.85	7.21
±SE		±0.68	±0.32	±0.24	±0.50	±0.02	±0.04
Min.		46.97	17.93	34.83	26.3	1.53	6.5
Max.		160.47	61.97	46.02	84.09	2.03	8.07
gcv		22.52	22.95	2.7	22.09	2.65	3.03
pcv		22.98	23.63	4.45	22.93	5.41	4.57
H b%		96	94.29	36.71	92.77	24.07	43.97
ΔG		41.02	15.96	1.36	21.53	0.05	0.31
ΔG/Mean %		47.66	48.13	3.53	45.95	2.81	4.34
Bulk		93.4	35.57	38.14	45.92	2.03	7.6
G95		117.3	45.37	38.69	64.25	1.83	7.57
S G86		129.53	48.17	37.18	61.77	2.1	7.37
LSD average 5%		7.94	4.13	3.38	5.89	0.17	0.48
LSD average 1%		10.45	5.44	4.45	7.76	0.23	0.64
Items	df	LI/g	MIC	PI	UHM	UI%	
MS Reps	2	5.64	0.03	0.13	1.15	1.39	
MS Entries	102	0.42**	0.38**	0.10**	1.35**	2.49**	
MS Error	204	0.25	0.02	0.05	0.2	0.22	
Mean		4.54	3.22	9.83	31.68	83.09	
±SE		±0.05	±0.01	±0.02	±0.05	±0.05	
Min.		3.74	2.63	9.38	30.29	81.47	
Max.		7.45	3.96	10.24	33.27	84.93	
gcv		5.43	10.8	1.37	1.93	1.06	
pcv		8.32	11.1	1.86	2.1	1.11	
H b%		42.51	94.68	53.97	84.54	91.6	
ΔG		0.35	0.73	0.21	1.22	1.82	
ΔG/Mean %		7.64	22.71	2.17	3.84	2.19	
Bulk		4.68	3.53	9.67	32.35	83.73	
G95		4.77	3.63	9.83	31.00	82.77	
S G86		4.38	3.33	10.07	32.63	83.83	
LSD average 5%		0.57	0.17	0.25	0.51	0.53	
LSD average 1%		0.75	0.22	0.32	0.68	0.69	

*,** significant at 0.05 and 0.01 levels of probability; respectively.
ΔG = expected genetic advance from selection the superior 8.33% of the families.
LSD. Average = to compare families mean with the bulk sample or the better parent.

2- Average direct observed gain for seed cotton yield in F₃-generation.

Table 6 showed the average observed direct gain from selection 100 families for seed cotton yield per plant in F_3-generation.

Table 6. The average observed direct and correlated gain from selection 100 families in percentage of bulk sample and the better parent in F3-generation, season 2020.

Items	Bulk	Better parent	LSD 5%	LSD 1%
SCY/P	-7.86*	-33.56**	7.79	10.25
LY/P	-6.79**	-31.18**	3.69	4.85
LP%	1.05	-0.39	2.69	3.54
NB/P	2.05	-27.07**	5.69	7.49
BW	-9.02**	-11.90**	0.17	0.23
SI	-5.13**	-4.71**	0.49	0.64
LI	-3.01**	-4.89**	0.56	0.74
MIC	-8.87**	-11.38**	0.16	0.21
PI	1.69**	-2.35**	0.24	0.32
UHM	-2.08**	-2.92**	0.52	0.68
UI%	-0.77**	-0.89**	0.52	0.69

* and ** Significant at 0.05 and 0.01 levels of probability, respectively.

Average correlated gains in percentage the better parent showed that all the studied traits showed significant (p≤0.01) decrease with range from -31.18% of LY/P to -0.89% you of UI with exception LP% that showed insignificant decrease by -0.39% (Table 6). Mahdy et al. (2009 a).

C- Evaluation of selection for seed cotton yield in F₄-generation, season 2021.

1- Means and variances

Mean squares of the 30 selected families for seed cotton yield along with the parents and bulk for the studied traits in F_4-generation are presented in (Table 7).

Entries mean squares of the selection criterion; seed cotton yield and lint yield/plant and number of bolls / plant were significant (P≤0.01). In addition significant (P≤0.05 or 0.01) differences for lint percentage and fiber length. Indicating sufficient retained genetic variability for further cycles of selection for these traits.

Phenotypic coefficient of variability; PCV% was slightly larger than the GCV% for all traits. The narrow differences between GCV and PCV% resulted in high estimates

of broad sense heritability for the seed cotton yield, lint yield/plant and number of branches/plant by 93.67, 91.07 and 82.72%, respectively (Table 7). Moderate estimates of broad sense heritability were recorded for lint percentage (53.56%) and fiber length (42.60%). Moreover, low values of broad sense heritability were estimated for the remained traits (Table 7). Mahdy et al. (2006), Abdel-Zaher et al. (2007), Khan et al. (2009), Hassaballa et al. (2012) and Yahia and Hassan (2015).

Mean seed cotton yield of the thirty selected families (Table 8) in the F_4-generation ranged from 59.13 to 165.47 with an average of 100.82 gm., Only two families; No.6 and No.9 were higher than the better parent Giza 95 and bulk sample in seed cotton yield, lint yield/plant and number of branches/plant. Selection for seed cotton yield resulted in insignificant increased for seed cotton yield, lint yield/plant and lint percentage compared to the bulk sample and lint percentage and index compared to the better parent. While, the rest traits

showed decreased compare to the bulk and better parent as a result to selection for seed cotton yield in F_4-generation.

Table 7. Mean squares, phenotypic (p.c.v.%), genotypic (g.c.v.%) coefficients of variation broad sense heritability (Hb%) for the 30 selected families for traits with the parents and bulk in F_4-generation, season, 2021.

S.V.	Reps	Entries	Error	g.c.v.%	p.c.v.%	H b%
df	2	32	64	-	-	-
SCY/P	14.92	1603.65**	101.58	21.98	22.71	93.67
LY/P	6.13	234.81**	20.98	20.82	21.82	91.07
LP	3.94	1.98**	0.92	1.48	2.03	53.56
BW	0.05	0.06	0.06	4.97	9.17	29.38
NB/P	69.26	485.01**	83.81	20.76	22.83	82.72
SI	1.74	0.13	0.1	1.27	2.74	21.59
LI	0.88	0.25	0.17	3.19	5.66	31.86
MIC	0.42	0.05	0.03	1.92	3.37	32.28
PI	2.65	0.16	0.18	0.58	2.47	5.56
UHM	0.83	0.54*	0.31	0.86	1.33	42.6
UI%	1.38	0.75	0.72	0.13	0.59	4.55

*, ** significant at 0.05 and 0.01 level of probability, respectively.

Table 8. Means of the studied traits for the 30 selected families, bulk sample and the two parents in F_4-generation.

Fam. no	SCY/P	LY/P	LP	BW	NB/P	SI	LI	MIC	PI	UHM	UI%
1	82.80	32.33	39.07	1.70	48.71	7.67	4.93	3.82	10.48	32.45	84.50
2	120.13	48.60	40.44	1.73	71.89	7.87	5.34	3.78	10.62	31.78	85.05
3	120.47	47.30	39.31	2.03	60.84	7.87	5.10	3.92	10.15	32.02	84.27
4	82.13	33.23	40.45	2.03	40.48	7.33	4.96	3.93	10.27	32.23	84.33
5	104.80	43.10	41.16	1.87	56.13	7.50	5.25	3.72	10.13	32.35	83.85
6	151.13	59.27	39.18	1.93	78.46	7.67	4.94	3.85	10.38	31.85	84.58
7	89.80	36.27	40.38	1.97	46.32	7.87	5.33	4.05	9.98	32.47	84.15
8	62.47	25.20	40.44	1.83	34.90	7.67	5.21	4.05	10.05	31.12	83.80
9	133.13	49.97	37.49	1.83	72.81	7.63	4.62	3.73	9.98	31.88	83.67
10	113.47	40.70	41.21	1.70	68.46	7.53	4.31	3.73	10.43	32.52	84.33
11	108.80	43.43	39.93	1.90	57.76	7.60	5.07	3.90	10.05	31.60	84.33
12	112.47	45.83	40.75	1.77	64.82	7.57	5.20	3.65	10.08	31.75	84.28
13	96.80	39.07	40.41	1.97	49.36	7.90	5.36	3.92	10.32	32.03	84.32
14	103.80	42.03	40.48	2.03	51.28	7.80	5.30	4.00	10.27	32.10	84.73
15	100.80	40.93	40.70	1.87	53.93	7.60	5.22	3.88	10.18	32.18	83.40
16	98.47	39.67	40.27	1.90	52.02	7.57	5.10	3.73	9.77	32.13	83.60
17	79.80	32.63	40.98	1.57	50.92	7.53	5.23	3.82	10.03	31.38	84.32
18	85.80	34.47	40.20	1.93	44.86	7.10	4.78	3.68	10.03	32.17	83.88
19	119.80	46.60	38.83	1.80	68.40	7.33	4.67	3.88	10.03	31.93	84.28
20	165.47	66.47	40.17	2.00	84.62	7.77	5.22	3.87	10.08	32.48	84.62
21	107.13	43.53	40.67	1.73	61.90	7.73	5.30	3.70	10.43	32.37	84.23
22	107.47	43.47	40.44	1.77	61.19	7.60	5.16	3.75	10.50	32.32	84.45
23	117.47	46.50	39.59	1.83	67.31	7.77	5.09	3.87	10.23	31.92	84.03
24	95.47	39.80	41.69	1.83	52.59	8.30	5.94	3.83	10.30	32.47	85.05
25	89.13	35.67	40.04	1.53	58.30	7.73	5.17	3.98	9.97	31.25	83.45
26	74.47	30.67	41.16	2.10	35.53	7.53	5.27	3.95	10.48	31.77	84.67
27	59.13	23.80	40.20	2.03	30.54	7.57	5.09	3.70	10.47	31.67	84.52
28	82.53	33.40	40.50	1.90	43.70	7.57	5.15	3.85	10.30	32.22	82.90
29	71.47	28.27	39.50	1.83	39.52	7.63	4.99	3.65	10.33	32.72	84.53
30	88.13	36.07	40.94	1.63	54.13	7.50	5.20	3.63	10.50	31.82	83.92
Average	100.82	40.28	40.22	1.85	55.39	7.64	5.12	3.83	10.23	32.03	84.20
Bulk	100.73	39.80	39.51	1.90	53.15	7.83	5.12	4.03	10.33	32.02	83.82
Giza 95	123.00	46.83	38.03	1.83	67.26	7.43	4.56	4.00	9.87	31.03	83.17
Giza 86	111.67	43.13	38.63	2.00	55.83	7.77	4.89	3.60	10.80	32.67	84.40
LSD 5%	16.83	7.65	1.60	0.41	15.29	0.54	0.69	0.31	0.71	0.93	1.41
LSD 1%	22.68	10.31	2.16	0.56	20.60	0.72	0.93	0.41	0.96	1.25	1.90

2- Observed direct and correlated response to selection for seed cotton yield.

Observed direct and correlated response to selection for seed cotton yield per plant in percentage the unselected bulk sample and the better parent in F_4-generation are shown in Tables 10 and 11.

Overall mean of the 30 selected families showed insignificant increase in the selection criterion; seed cotton yield per plant than the unselected bulk sample by 0.09% and insignificant increase in the correlated traits lint yield/plant, lint percentage, number of bolls /plant, fiber length and uniformity index by 1.19, 1.79, 4. 21, 0.05 and 0.46%, respectively (Table 10). Four selected families no. 2, 6, 9 and 20 were showed significant (p≤0.05 or 0.01) increase

compared to the bulk sample of the selection criterion seed cotton yield/plant by 19.26, 50.03, 32.16 and 64.26%, respectively and increase in two correlated traits lint yield/plant by 22.11, 48.91, 25.54 and 67.00 %, respectively, and number of bolls per plant by 35.25, 47.61, 36.99 and 59.21%, respectively (Table 10). Moreover, the family no. 3 and 19 surpassed significant (p≤0.05) the bulk sample in the selection criterion SCY by 19.59 and 18.93%, respectively. Nine selected families no. 5, 10, 11, 12, 14, 15, 21, 22 and 23 were showed insignificant increase in selection criterion seed cotton yield/pant than the bulk sample with ranged from 0.07% of no. 15 to 16.61% of family no 23. Also, the same nine families in addition no. 3 and 19 were showed insignificant increase compared the bulk sample in lint

yield/plant ranged from 2.26% of family no. 10 to 18.84% of family no. 3 (Table 10). Soomro et al. (2010), Hassaballa et al. (2012), Kazerani (2012) and Soliman (2018).

For lint percentage, out of the 30 selected families, four families no. 5, 10, 24 and 26 showed significant increase by 4.17, 4.30, 5.52 and 4.18%, respectively compared to the undetected bulk sample. While, twenty selected families were showed insignificant increase ranged from 1.07% of family no. 11 to 3.72% of family no. 17 than the bulk sample. Meanwhile, the rest six selected families were showed significant or insignificant decrease in lint percentage compared to the bulk sample. In comparison with the bulk (Table 10). It's found that eighteen selected families were showed significant (p≤0.05 or 0.01) increase in lint percentage ranged from 4.25% of family no. 16 to 7.92% of family no 24 and 11 selected families surpassed insignificant the better parent in lint percentage ranged from 0.51% of family no. 19 to 4.07 % of family no. 18. Only one family no. 9 that gave insignificant decrease by -2.94% in LP compared to the better parent (Table 11). Mabrouk (2020) reported similar results.

Table 10. Observed direct and correlated response to selection seed cotton yield (F₄) in percentage of the bulk; season 2021.

F.N	SCY/P	LY/P	LP	BW	NB/P	SI	LI	MIC	PI	UHM	UI%
1	-17.80*	-18.76	-1.12	-10.53	-8.37	-2.13	-3.63	-5.37	1.45	1.35	0.82
2	19.26*	22.11*	2.35	-8.77	35.25*	0.43	4.33	-6.20	2.74	-0.73	1.47
3	19.59*	18.84	-0.51	7.02	14.46	0.43	-0.44	-2.89	-1.77	0.00	0.54
4	-18.46*	-16.50	2.37	7.02	-23.84	-6.38	-3.05	-2.48	-0.65	0.68	0.62
5	4.04	8.29	4.17*	-1.75	5.60	-4.26	2.59	-7.85*	-1.94	1.04	0.04
6	50.03**	48.91**	-0.84	1.75	47.61**	-2.13	-3.46	-4.55	0.48	-0.52	0.91
7	-10.85	-8.88	2.20	3.51	-12.85	0.43	4.10	0.41	-3.39	1.41	0.40
8	-37.99**	-36.68**	2.34	-3.51	-34.34*	-2.13	1.79	0.41	-2.74	-2.81	-0.02
9	32.16**	25.54*	-5.10*	-3.51	36.99*	-2.55	-9.78	-7.44	-3.39	-0.42	-0.18
10	12.64	2.26	4.30*	-10.53	28.79*	-3.83	-15.78*	-7.44	0.97	1.56	0.62
11	8.01	9.13	1.07	0.00	8.67	-2.98	-1.00	-3.31	-2.74	-1.30	0.62
12	11.65	15.16	3.15	-7.02	21.94	-3.40	1.65	-9.50*	-2.42	-0.83	0.56
13	-3.90	-1.84	2.28	3.51	-7.13	0.85	4.68	-2.89	-0.16	0.05	0.60
14	3.04	5.61	2.46	7.02	-3.52	-0.43	3.61	-0.83	-0.65	0.26	1.09
15	0.07	2.85	3.00	-1.75	1.46	-2.98	2.00	-3.72	-1.45	0.52	-0.50
16	-2.25	-0.34	1.93	0.00	-2.13	-3.40	-0.33	-7.44	-5.48	0.36	-0.26
17	-20.78*	-18.01	3.72	-17.54	-4.21	-3.83	2.15	-5.37	-2.90	-1.98	0.60
18	-14.82	-13.40	1.75	1.75	-15.61	-9.36**	-6.63	-8.68*	-2.90	0.47	0.08
19	18.93*	17.09	-1.73	-5.26	28.69	-6.38	-8.70	-3.72	-2.90	-0.26	0.56
20	64.26**	67.00**	1.67	5.26	59.21**	-0.85	1.86	-4.13	-2.42	1.46	0.95
21	6.35	9.38	2.94	-8.77	16.45	-1.28	3.59	-8.26*	0.97	1.09	0.50
22	6.68	9.21	2.34	-7.02	15.12	-2.98	0.84	-7.02	1.61	0.94	0.76
23	16.61	16.83	0.19	-3.51	26.63	-0.85	-0.59	-4.13	-0.97	-0.31	0.26
24	-5.23	0.00	5.52*	-3.51	-1.05	5.96	15.96*	-4.96	-0.32	1.41	1.47
25	-11.52	-10.39	1.34	-19.30	9.68	-1.28	0.90	-1.24	-3.55	-2.39	-0.44
26	-26.08**	-22.95*	4.18*	10.53	-33.15*	-3.83	2.90	-2.07	1.45	-0.78	1.01
27	-41.30**	-40.20**	1.74	7.02	-42.55**	-3.40	-0.68	-8.26*	1.29	-1.09	0.84
28	-18.07	-16.08	2.51	0.00	-17.78	-3.40	0.54	-4.55	-0.32	0.62	-1.09
29	-29.05**	-28.98**	-0.03	-3.51	-25.26	-2.55	-2.62	-9.50*	0.00	2.19	0.86
30	-12.51	-9.38	3.62	-14.04	1.83	-4.26	1.51	-9.92*	1.61	-0.62	0.12
Average	0.09	1.19	1.79	-2.51	4.21	-2.43	-0.06	-5.10	-1.02	0.05	0.46
LSD5%	16.71	19.22	4.05	21.80	28.76	6.86	13.43	7.63	6.88	2.90	1.69
LSD1%	22.52	25.90	5.46	29.38	38.76	9.24	18.10	10.28	9.28	3.91	2.27

*, ** significant at 0.05 and 0.01 level of probability, respectively.

For the selection criterion; SCY compared to the better parent, average the 30 selected families were showed negative insignificant (p≤0.05) response to selection by -18.03%. and insignificant decrease in the correlated traits; LY/P, BW, NB/P, SI, MIC, PI, UHM and UI % by -14.00, -7.39, -17.65, -1.59, -4.31, -5.29, -1.95 and -0.23%, respectively (Table 11).

For lint index, only one selected family no. 24 was showed significant increase (p≤0.05 and 0.01) compared to the bulk sample by 15.96% and the better parent by 21.41% (Tables 10 and 11).

All selected families were showed insignificant negative response to selection of lint yield compared to the better parent (Table 11). For boll weight, seed index, fiber fineness, fiber strength, fiber length and uniformity index, all selected families were showed insignificant negative or positive response to selection compared to the unselected bulk sample and the better parent (Tables 10 and 11). Shaheen et al. (2000), El-Defrawy and El-Ameen (2004) and El-Okkiah et al. (2008)

3- Effect of selection on correlations among traits in F₄-generation.

The selection criterion seed cotton yield per plant showed strong positive genotypic and phenotypic correlation with each of lint yield per plant by 0.99 and number of bolls per plant 0.97 and 0.95, respectively. Moreover, low positive with boll weight by 0.05, seed index (0.21 and 0.18), fiber length (0.21 and 0.19) and uniformity index (0.20 and 0.17) on genotypic and phenotypic levels, with negative correlation with lint percentage (-0.43 and -0.33), fiber fineness (-0.06 and 0.05), lint index (-0.24 and -0.19) and fiber strength (-0.14 and -0.10). Younis (1999), El-Okkiah et al. (2008), Mahrous, H. and A.M. Soliman(2017)

Lint yield/plant was showed positive genotypic and phenotypic correlation with ranged from low of boll weight (0.08 and 0.07) to strong of number of bolls per plant (0.96 and 0.93). While, the rest studied traits LP, LI, MIC and PI were showed negative correlation with LY/P.

Lint percentage was showed high positive correlation with lint index by 0.88 and low positive correlation with BW, SI and MIC on genotypic and phenotypic levels, while negative correlation with the number of bolls per plant and the rest fiber quality traits.

Bolls weight was showed positive genotypic correlation with all the studied traits with exception number of bolls per plant where the genotypic and phenotypic correlation were negative by - 0.17 and - 0.25 (Table 12). Younis (1999), El-Okkiah et al. (2008), Mahrous, H. and A.M. Soliman (2017)

Number of bolls per plant was shown positive correlation with seed index, fiber length and uniformity index. Seed index showed positive genotypic and phenotypic correlations with all the studied traits (Table 12). Lint index was showed positive correlation with each of fiber fineness (0.38 and 0.23) and uniformity index (0.23) on genotypic and phenotypic levels. Younis (1999), El-Okkiah et al. (2008), Mahrous, H. and A.M. Soliman (2017)

Table 11. Observed direct and correlated responses to selection seed cotton yield (F₄) in percentage of the better parent of season, 2021

F.N	SCY/P	LY/P	LP	BW	NB/P	SI	LI	MIC	PI	UHM	UI%
1	-32.68**	-50.13**	1.13	-15.00	-27.59*	-1.33	0.89	-4.58	-2.93	-0.67	0.12
2	-2.33	-25.03**	4.69*	-13.33	6.89	1.24	9.23	-5.42	-1.70	-2.71	0.77
3	-2.06	-27.04**	1.76	1.67	-9.54	1.24	4.24	-2.08	-6.02	-2.00	-0.16
4	-33.22**	-48.74**	4.70*	1.67	-39.81**	-5.62	1.51	-1.67	-4.94	-1.34	-0.08
5	-14.80*	-33.52**	6.54**	-6.67	-16.55	-3.47	7.41	-7.08	-6.17	-0.98	-0.65
6	22.87**	-8.58	1.42	-3.33	16.65	-1.33	1.08	-3.75	-3.86	-2.51	0.22
7	-26.99**	-44.06**	4.53*	-1.67	-31.13*	1.24	8.99	1.25	-7.56*	-0.62	-0.30
8	-49.21**	-61.13**	4.67*	-8.33	-48.11**	-1.33	6.58	1.25	-6.94*	-4.75**	-0.71
9	8.24	-22.93**	-2.94	-8.33	8.26	-1.76	-5.54	-6.67	-7.56*	-2.41	-0.87
10	-7.75	-37.22**	6.67**	-15.00	1.78	-3.05	-11.82	-6.67	-3.40	-0.47	-0.08
11	-11.54	-33.00**	3.37	-5.00	-14.12	-2.19	3.65	-2.50	-6.94*	-3.28*	-0.08
12	-8.56	-29.30**	5.50*	-11.67	-3.63	-2.62	6.43	-8.75*	-6.64*	-2.82	-0.14
13	-21.30**	-39.74**	4.61*	-1.67	-26.61*	1.67	9.60	-2.08	-4.48	-1.95	-0.10
14	-15.61*	-35.16**	4.80*	1.67	-23.75*	0.39	8.48	0.00	-4.94	-1.74	0.39
15	-18.05*	-36.86**	5.35*	-6.67	-19.82	-2.19	6.80	-2.92	-5.71	-1.49	-1.18
16	-19.95**	-38.81**	4.25*	-5.00	-22.66	-2.62	4.35	-6.67	-9.57**	-1.64	-0.95
17	-35.12**	-49.66**	6.08**	-21.67*	-24.30*	-3.05	6.95	-4.58	-7.10*	-3.94**	-0.10
18	-30.24**	-46.84**	4.07	-3.33	-33.31**	-8.62**	-2.25	-7.92*	-7.10*	-1.54	-0.61
19	-2.60	-28.12**	0.51	-10.00	1.70	-5.62	-4.41	-2.92	-7.10*	-2.25	-0.14
20	34.53**	2.52	3.99	0.00	25.82*	-0.04	6.65	-3.33	-6.64*	-0.57	0.26
21	-12.90	-32.85**	5.28*	-13.33	-7.98	-0.47	8.46	-7.50	-3.40	-0.93	-0.20
22	-12.63	-32.95**	4.68*	-11.67	-9.02	-2.19	5.57	-6.25*	-2.78	-1.08	0.06
23	-4.50	-28.27**	2.48	-8.33	0.07	-0.04	4.08	-3.33	-5.25	-2.31	-0.43
24	-22.38**	-38.61**	7.92**	-8.33	-21.81	6.82	21.41**	-4.17	-4.63	-0.62	0.77
25	-27.53**	-44.98**	3.65	-23.33*	-13.33	-0.47	5.64	-0.42	-7.72*	-4.35**	-1.13
26	-39.46**	-52.70**	6.56**	5.00	-47.17**	-3.05	7.74	-1.25	-2.93	-2.77	0.32
27	-51.92**	-63.29**	4.06	1.67	-54.60**	-2.62	3.99	-7.50	-3.09	-3.07	0.14
28	-32.90**	-48.48**	4.84*	-5.00	-35.02**	-2.62	5.26	-3.75	-4.63	-1.39	-1.78*
29	-41.90**	-56.40**	2.25	-8.33	-41.24**	-1.76	1.96	-8.75*	-4.32	0.14	0.16
30	-28.35**	-44.37**	5.99**	-18.33	-19.53	-3.47	6.28	-9.17*	-2.78	-2.61	-0.57
Average	-18.03*	-14.00	4.13	-7.39	-17.65	-1.59	4.71	-4.31	-5.29	-1.95	-0.23
LSD5%	13.68	16.33	4.14	20.71	22.73	6.92	14.06	7.69	6.59	2.85	1.67
LSD1%	18.44	22.01	5.59	27.91	30.63	9.32	18.95	10.37	8.88	3.83	2.26

*, ** significant at 0.05 and 0.01 level of probability, respectively.

Fiber fineness was showed negative phonotypic correlation with each of fiber strength (-0.24), fiber length (-0.28) and uniformity index (-0.01). Positive genotypic and phenotypic correlation coefficients were observed among fiber strength, length and uniformity index with ranged from weak between UHM and UN (0.12 and 0.17) to strong between fiber strength and uniformity index by (0.71 and 0.48.) (Table 12).

Table 12. Coefficients of genotypic (rg) and phenotypic (rp) correlation among the studied traits in F₄-generation.

	r	LY/P	LP	BW	NB/P	SI	LI	MIC	PI	UHM	UI%
SCY/P	rg	0.99	-0.43	0.05	0.97	0.21	-0.24	-0.06	-0.14	0.21	0.20
	rp	0.99	-0.33	0.05	0.95	0.18	-0.19	-0.05	-0.10	0.19	0.17
LY/P	rg		-0.32	0.08	0.96	0.25	-0.14	-0.04	-0.17	0.21	0.21
	rp		-0.19	0.07	0.93	0.21	-0.06	-0.03	-0.11	0.18	0.19
LP	rg			0.21	-0.50	0.23	0.88	0.20	-0.27	-0.23	-0.06
	rp			0.12	-0.38	0.12	0.88	0.12	-0.05	-0.15	0.07
BW	rg				-0.17	0.05	0.13	0.35	0.12	0.28	0.28
	rp				-0.25	0.02	0.07	0.32	-0.03	0.23	0.17
NB/P	rg					0.19	-0.29	-0.15	-0.13	0.12	0.17
	rp					0.17	-0.23	-0.15	-0.06	0.10	0.14
SI	rg						0.65	0.47	0.24	0.14	0.59
	rp						0.56	0.31	0.15	0.11	0.37
LI	rg							0.38	-0.12	-0.12	0.23
	rp							0.23	0.02	-0.07	0.23
MIC	rg								-0.30	-0.33	0.03
	rp								-0.24	-0.28	-0.01
PI	rg									0.31	0.71
	rp									0.22	0.48
UHM	rg										0.12
	rp										0.17

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استجابة الانتخاب لمحصول القطن الزهر لهجين القطن المصري (جيزة 95 × سوبر جيزة 86) تحت ظروف الأراضي حديثة الاستصلاح

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الملخص

أجريت هذه الدراسة في مزرعة غرب المنيا تحت ظروف الأراضي الجديدة خلال ثلاث مواسم زراعيه 2019 ، 2020 ، 2021 وذلك لدراسة استجابة الانتخاب لصفة محصول القطن الزهر للنبات للأجيال الانعزالية لهجين القطن (جيزة 95 x سوبر جيزة 86) وكانت النتائج كالتالي :- أشارت النتائج لوجود مدى واسع لصفة محصول القطن الزهر/ نبات للجيل الثاني يتراوح ما بين 16.4 - 186.0 جرام لقدرة تأثير الانتخاب لهذه الصفة. كان متوسط مربعات الانتخاب لصفات محصول القطن الزهر/ نبات و محصول القطن الشعر/ نبات و عدد اللوز / نبات للنبات عالية المعنوية في الجيل الثاني. كانت درجة التوريث أكبر من 82.71% لصفات محصول القطن الزهر/ نبات و محصول القطن الشعر/ نبات وعدد اللوز / نبات. تشير النتائج الى تفوق العائلتين رقمي 6 و 9 بالمقارنة بالأب الأفضل جيزة 90 وكذلك للإجمالي للجيل الرابع. أظهرت العائلات المنتخبة أرقام 2 و 6 و 9 و 20 بأنها عالية المعنوية بالمقارنة بكل من عينات الاجمالي لصفة محصول القطن الزهر / نبات بنسب 19.26% و 50.03% و 32.16% و 64.26% على الترتيب. أظهر الارتباط الوراثي والمظهري لصفة محصول القطن الزهر / نبات تأثيراً موجب المعنوية بالنسبة لصفتي محصول القطن الشعر/ نبات بنسبة 99 % و عدد اللوز/ نبات بنسبة 97 % و الارتباط موجب وغير معنوي للصفات وزن اللوزة و معامل البذرة وطول الشعر ومعامل الانتظام بينما كان تأثير الارتباط سالب لصفات تصافى الحليج ومعامل الشعر ونعومة الشعر ومتانة الشعر.

الكلمات الدالة: الانتخاب ـ القطن المصري ـ العشائر ـ التباين الوراثي