Egypt. J. Plant Breed. 24(2):413– 433(2020)

SELECTION FOR IMPROVING SOME YIELD TRAITS IN COTTON

AL Hibbiny Y.I.M.

Cotton Research Institute, Agricultural Research Center, Giza, Egypt

ABSTRACT

The present study was carried out at Sakha Agricultural Research Station, Cotton Research Institute, Agricultural Research Center, Egypt, during 2017 to 2019 seasons. Seven selection procedures (Application 1 to 7) i.e. direct selection for three separately traits (lint cotton yield/plant, bolls/plant and boll weight), Multiplicative index of Subandi et al (1973) involved lint cotton yield/plant, bolls/plant and boll weight and three selection index involved lint cotton yield/plant, bolls/plant and boll weight, lint cotton yield/plant, bolls/plant, boll weight, seed index, lint percentage, lint index and all the studied traits (yield and fiber traits), respectively, to improve lint yield, yield components and fiber properties in early segregating generations; F_2, F_3 and F_4 of a cotton cross (Egyptian variety Giza 87 x Australian genotype 10229). Most of yield traits means in F_4 generation were higher than F_3 generation via the genetic improvement using the selection procedures. Fiber traits means in F_3 and F_4 generations were almost the same in values which reflect the early fixation of most of the genetic components of these traits. PCV and GCV for lint cotton yield/plant, bolls/plant and boll weight were larger in F_2 generation than those of the succeeding generations. Most of the studied traits showed moderate to high heritability in broad sense in all generations except for bolls/plant and boll weight in F_4 generation. Most of fiber traits showed higher heritability in F_3 and F_4 generations than F_2 one. Genotypic correlations between lint cotton yield/plant and bolls/plant in the three generations were positive and highly significant. In F_4 generation boll weight showed significant and positive genotypic correlation with almost all the studied traits. Besides, fiber length showed the same trend with boll weight, seed index, lint index and lint percentage. In the direct selection for lint cotton yield/plant and bolls/plant the highest predicted and realized gains from all generations were obtained with direct selection for lint cotton yield/plant and direct selection for bolls/plant in both applications which ranged from 17.43 % with bolls/plant in F_4 to 90.49% with lint cotton yield/plant in F_2 to application 1 and 2. Direct selection for boll weight (application 3) could increase itself and seed index, lint index, micronaire reading and fiber length. The predicted and realized gains in application 5 and 6 were positive and relatively high for lint cotton yield/plant and bolls/plant in the three generations; and were positive and slightly high for lint percentage, lint index, micronaire reading and fiber length in F_4 generation. The predicted and realized gains in application 6 for lint cotton yield/plant and bolls/plant were relatively high in the three generations this mean selection for all yield traits could improve lint cotton yield/plant and bolls/plant by 32.7% and 24.61% in F_4 generation. Other yield traits were slightly improved applying this selection procedure, this improvement ranged from 1.05 % for seed index to 8.44% for lint index. Fiber traits were also slightly improved except micronaire reading and uniformity index. Application 7 showed improvements for all the studies traits except micronaire reading. The improvement for lint cotton yield/plant and bolls/plant were not relatively high as the same in the other selection procedures, however boll weight and lint index were relatively high, and the lowest ones were for fiber traits. Four families released from these seven selection applications in F_4 generation combined lint yield and most of favorable fiber traits and exceeded the F_4 generation mean. These families could be continued to further generations as breeding genotypes for developing higher yield and fiber.

Key words: ***Cotton, Selection, Predicted gain, Realized gain***

INTRODUCTION

Selection is a screening process, not a mending or a making. By getting rid of the poor plants we have more good ones. If all the plants are good the object of selection is fully attained. The breeder works entirely by elimination, his only direct action being upon the plants that are rejected and destroyed. The plants that are retained are not altered but merely allowed to reproduce. Success in cotton improvement programme depends on the amount of genetic variability and its utilization. In population improvement it is important to determine the extent of genetic variation for traits to be improved. The genetic information on broad sense heritability and genetic advance are very important to predict the behavior of the parents to be utilized in breeding programme for selecting high yielding cultivars. High genetic advance coupled with high heritability estimates offers a most effective response to selection (Larik *et al* 1997).

Smith (1936) first suggested the use of concept of a "discriminant function" as a legical and systematic manner of selecting plant lines to improve several quantitative characters simultaneously. The object of index selection is to maximize the average "genetic worth" of a population. Genetic worth is the sum of products of the genotypic values of the measured characters and their respective "economic weights". Thus, genetic worth reflects the overall value of a particular line or individual. Hazel (1943) extended the index procedure for the selection of individuals in animal population. Construction of the SMITH - HAZEL index involves economic weightings of each trait along with genotypic and phenotypic variances and covariances between each pair of traits, and coefficients of phenotypic weights (b_s). This method has generally permitted good results in improving the yield in cotton (Kamalanathan 1967, El-Okkia 1979, Mahdy 1983, Al-Rawi and Ahmed 1984, Hassaballa *et al* 1987, Mahdy *et al* 1987, Younis 1999, El-Lawendey 2003, El-Lawendey *et al* 2008, Kassem *et al* 2008, Soliman and El-Lawendey 2008, El-Mansy 2009, El-Lawendey *et al* 2011 and Soliman 2018).

The genetic variation and genotypic correlation between different plant characters is available in literature. The studies of Khan (2003) showed that the yield was found positively correlated with bolls/plant and boll weight. Further studies in this respect also indicated that 99% of both

genotypic and phenotypic variation in lint yield could be explained by the three component traits. These results suggested that selection for these three component traits could be effective in improving lint yield. Indeed, it has been recommended that bolls/plant be used as the primary selection trait, followed by boll weight and lint percentage (Huang *et al* 2003 and Li *et al* 2009). However, bolls/plant is negatively correlated with boll weight , a balanced selection for bolls/plant and boll weight might be needed (Iqbal *et al* 2006, McCarty *et al* 2008, Li *et al* 2009 and El-Lawendey *et al* 2011). Abbas *et al* (2013) indicated that selection of the basis of significant correlation among trait may be helpful to improve cotton yield and quality. El-Lawendey and El-Dahan (2012) obtained the heritability estimates in both F_3 and F_4 generations ranged from moderate to high (51.3 to 96.3%) for all traits. These estimates indicate a possible success in the selection of the early generations.

The objectives of this study were to: (I) report and compare the predicted and realized genetic gains by the methods: direct selection, classical selection index of Smith & Hazel and multiplicative index of Subandi *et al* (1973) to enhance selection of superior promising cotton families. (II) find a relationship of yield contributing and quality traits in F_2, F_3 and F_4 generations.

MATERIALS AND METHODS

Genetic materials and selection procedures

This study was conducted for three seasons (2017-2019) at Sakha Agricultural Research Station. Cotton Research Institute, Agricultural Research Center, Egypt, The materials used were the F_2, F_3 and F_4 generations of the intraspecific cotton (*Gossypium barbadense* L.) cross (Egyptian variety Giza 87 x Australian genotype 10229). Giza 87 is extremely good for fiber quality. Australian genotype 10229 charactrized by high yield and earliness.

In 2017 season, F_2 generation with the two original parents were grown in unreplicated rows of 7.5 meter length adopting a spacing of 70 cm between rows and 75 cm between the plants in the row. One plant was left per hill at thinning time. Self pollination was practiced for all F_2 plants. Selfed as well as open pollinated bolls/plant of 300 guarded plants were picked up separately. Lint cotton yield (g)/plant (LCY/P) , bolls/plant (B/P)

, boll weight (BW) , seed index (SI), lint percentage (L%), lint index (LI), micronaire reading (MR), pressley index , fiber length at 2.5% (FL) and uniformity index (UI) were recorded for all F_2 plants. Fifteen superior progenies having the highest performance for seven selection applications were selected. These gave a total of 58 F_3 selected.

In 2018 season, part of selfed seeds of 58 selected progenies were evaluated with parental genotypes in a randomized complete blocks design with three replicates. Experimental plot consisted of one row of 6.0 meter in length and 70 cm in width. Seeds were planted in hills spaced 40 cm apart and one plant was left per hill at thinning time.

Different selection procedures were applied. These selection procedures include:

Application 1 (Direct selection for LCY/P).
Application 2 (Direct selection for B/P).
Application 3 (Direct selection for BW).
Application 4 (A multiplicative index of Subandi *et al* 1973 involved LCY/P, B/P and BW).
Application 5 (Classical selection index involved LCY/P, B/P and BW).
Application 6 (Classical selection index involved LCY/P, B/P, BW, SI, L% and LI).
Application 7 (Classical selection index involved all studied characters).

Six superior progenies of each selection procedure were selected using 10.0% selection intensity. These gave a total of 14 F_4 selected progenies. In 2019 season, selfed seeds of the 14 selected progenies were evaluated with parental genotypes similar to that in 2018. The studied traits in F_3 and F_4 were the same as in F_2 generation.

All fiber properties were measured in the laboratories of the Cotton Technology Research Division, Cotton Research Institute, Agricultural Research Center, Giza, Egypt.

Statistical and genetic analysis

The analysis of variance and covariance on plot mean basis in F_3 and F_4 generations are presented in Table 1.

Table 1. Analysis of variance and covariance on plot mean basis in F_3 and F_4 generations.

SOV	df	MS	EMS	
			Variance	Covariance
Replications	**(r-1)**			
Families	**(f-1)**	**MF**	$\sigma^2e + r\,\sigma^2g$	$\sigma e_{ij} + r\,\sigma g_{ij}$
Error	**(r-1) (f-1)**	**ME**	σ^2e	σe_{ij}
Total	**(rf-1)**			

The phenotypic (PCV) and genotypic (GCV) coefficients of variation were estimated using the formula developed by Burton (1952). Heritability in broad sense (h^2b) was calculated according to Walker (1960). Genotypic correlation coefficients between studied traits were estimated as outlined by Miller *et al* (1958), and Dewey and Lu (1959).

The expected gain through direct selection (SG_x)

$SG_x = i \,.\, \sigma g_x \,.\, h_{bx}$

Where:

i denotes selection intensity obtained considering a selection of 5% (in F_2) and 10.3% (in F_3) among progenies, σg_x denotes standard deviation of the genotypic variance of trait x and h_{bx} denote square root of heritability in broad sense.

Multiplicative index (S-index) was calculated according to the formula Subandi *et al* (1973)

SUB-index = $X_1\ (100\text{-}X_2)(100\text{-}X_3)$.

The correlated response in one trait (Gs_k) expected from selecting was calculated as follows:

$Gs_k = i\ .\sigma g_{kl} / (\sigma_I)^{½}$

Where:

i is the selection differential in standard units , σg_{kl} is the estimate of genotypic covariance between k^{th} trait, and the index and σ_I is the variance of the index

Similarly, classical selection index (SH-index) was calculated from the formula of Smith (1936) and Hazel (1943):

SH-index = $b_1X_1 + b_2X_2 + \ldots..+b_nX_n$

The appropriate index weights (b_s) were calculated from the following formula postulated by Smith (1936) and Hazel (1943):

$(b) = (P)^{-1}. (G). (a)$

Where:

(b) =Vector of relative index coefficients,

$(P)^{-1}$ = Inverse phenotypic variance-covariance matrix,

(G) = Genotypic variance-covariance matrix,

(a) =Vector of relative economic values on the basis of equally important, i.e., $(a)_{LCY} = (a)_{B/P} = (a)_{BW} =.....= (a)_{UI} = 1$

The expected gain for trait j (SG_j) in index-based was estimated according to the following expression:

SG_j (SH-index)= i b_s G_j /$(V(I))^{½}$

Where:

i denotes selection intensity obtained considering a selection of 5% (in F2) and 10.3% (in F3).

b_s denotes vector of weighting coefficients of the traits in the selection index. G_j denotes x^{th} row of matrix G.

V (I) denotes index variance.

The realized gains was calculated as deviation of generation mean for each character from procedure mean of that character.

RESULTS AND DISCUSSION

Means, phenotypic and genotypic coefficients of variation and heritability estimates

Means, phenotypic (PCV) and genotypic (GCV) coefficients of variation, and heritability values in broad sense for all traits in F_2, F_3 and F_4 generations are presented in Table 2. Mean values showed higher values in F_2 generation for most the studied traits compared to F_3 and F_4 generations. These results can be attributed to the using of individual plants in F_2 generation instead of families in F_3 and F_4 generations. This procedure increases the environment effects and plant growth rate forming vigorous plants. Most of yield traits means in F_4 generation were higher than F_3 generation indicating the relized genetic improvement using the selection procedures.

Table 2. Means, standard errors (SE), phenotypic (PCV) and genotypic (GCV) coefficients of variation and broad sense heritability (h^2_b) for the studied characters in F_2, F_3 and F_4 generations.

Character	Generation	Mean ± SE	PCV%	GCV%	h^2_b
LCY(g)/P	F_2	36.14 ± 0.971	46.54	42.05	81.67
	F_3	14.01 ± 3.495	37.73	28.30	56.29
	F_4	24.52 ± 4.742	27.48	19.53	50.48
B/P	F_2	32.89 ± 0.848	44.63	41.33	85.75
	F_3	14.08 ± 3.270	37.10	28.93	60.79
	F_4	23.28 ± 4.733	26.05	16.28	39.08
BW (g)	F_2	3.02 ± 0.017	9.77	9.20	88.73
	F_3	2.92 ± 0.121	6.94	5.58	64.52
	F_4	2.97 ± 0.162	6.37	3.29	26.59
SI (g)	F_2	10.08 ± 0.039	6.65	5.55	69.48
	F_3	10.84 ± 0.258	4.38	3.68	70.61
	F_4	9.53 ± 0.458	7.94	6.33	63.43
L%	F_2	36.27 ± 0.078	3.74	3.29	77.34
	F_3	33.87 ± 0.747	4.50	3.92	76.01
	F_4	35.87 ± 0.706	4.38	3.91	79.77
LI (g)	F_2	5.74 ± 0.027	8.08	7.12	77.76
	F_3	5.57 ± 0.223	7.92	6.84	74.54
	F_4	5.33 ± 0.269	9.49	8.04	71.83
MR	F_2	3.98 ± 0.016	6.84	5.64	67.99
	F_3	3.88 ± 0.060	5.67	5.45	92.51
	F_4	3.91 ± 0.059	7.77	7.62	96.18
PI	F_2	10.57 ± 0.028	4.59	3.59	60.96
	F_3	10.07 ± 0.107	2.95	2.75	86.98
	F_4	10.00 ± 0.092	3.54	3.42	93.30
FL (mm)	F_2	35.04 ± 0.051	2.54	2.25	78.81
	F_3	32.63 ± 0.231	2.54	2.44	92.24
	F_4	31.94 ± 0.250	2.70	2.59	91.61
UI	F_2	87.31 ± 0.051	1.01	0.76	57.57
	F_3	84.45 ± 0.235	0.97	0.93	91.81
	F_4	83.15 ± 0.220	0.79	0.75	88.92

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

Regarding to fiber traits means in F_3 and F_4 generations were almost the same in values which reflect the early fixation of most of the genetic

components of these traits. Regarding to PCV and GCV for lint cotton yield/plant, bolls/plant and boll weight they were larger in F_2 generation than those of the succeeding generations. This indicates that, the magnitude of the genetic variability persisted in these materials was sufficient for providing rather substantial amounts of improvement through the selection of superior progenies. Similar results were obtained by Meena *et al* (2001) and El-Lawendey (2003). Most of the studied traits except lint cotton yield/plant and bolls/plant showed that the differences between PCV and GCV in F_3 and F_4 generations were not high especially for fiber traits which indicate the increasing of homogeneity between selected families across generations and the less effect of environmental factors. Most of the studied traits showed moderate to high heritability in broad sense in all generations except for bolls/plant and boll weight in F_4 generation. These results indicate the possibility of continued improvement of these traits applying the selection procedures. Most of fiber traits showed higher heritability values in F_3 and F_4 generations than F_2 one. These results confirm the decreasing of the environments effects for these traits across successive generations.

Genotypic correlation

Estimates of genotypic (r_g) correlation coefficients between studied characters in F_2, F_3 and F_4 generations are presented in Table (3). Genotypic correlations between lint cotton yield/plant and bolls/plant in the three generations were positive and highly significant indicating that bolls/plant was the most effective yield-contributing variable. Similar results were reported by Abo-Sen (2001) and AL Hibbiny *et al* (2019). Also, lint cotton yield/plant showed positive genotypic correlations with boll weight, seed index and lint index in F_2 generation, but this relationship alternated from F_3 to F_4 generations which indicate that selection cannot maintain this association, but it could cause changes in gene frequency. In F_4 generation boll weight showed significant and positive genotypic correlation with almost all the studied traits, and fiber length showed the same trend with boll weight, seed index, lint index and lint percentage this indicates that after selection cycles and genes rearrange and fixation of genetic structures, boll weight and fiber length shared most of genetic control with the mentioned traits.

Table 3. Estimates of genotypic correlation coefficients (rg) in F_2, F_3 and F_4 generations between all pairs of studied traits.

Generation		LCY(g)/P	B/P	BW (g)	SI (g)	L%	LI (g)	MR	PI	FL (mm)
B/P	F_2	0.97**								
	F_3	0.97**								
	F_4	0.94**								
BW (g)	F_2	0.22**	0.03							
	F_3	0.23	0.03							
	F_4	-0.01	-0.45							
SI (g)	F_2	0.22**	0.13*	0.49**						
	F_3	-0.40**	-0.48**	0.40**						
	F_4	-0.38	-0.56*	0.63*						
L%	F_2	0.07	0.02	-0.07	-0.15**					
	F_3	0.19	0.03	-0.05	-0.10					
	F_4	0.47	0.18	0.74**	-0.14					
LI (g)	F_2	0.23**	0.12*	0.32**	0.67**	0.63**				
	F_3	-0.07	-0.26*	0.17	0.46**	0.84**				
	F_4	0.06	-0.30	1.06**	0.66*	0.66*				
MR	F_2	-0.02	-0.05	0.30**	0.56**	-0.03	0.41**			
	F_3	-0.07	-0.09	-0.13	-0.17	0.22	0.11			
	F_4	0.35	0.28	0.75**	0.22	-0.21	0.03			
PI	F_2	-0.10	-0.05	-0.28**	-0.24**	-0.06	-0.25**	-0.71**		
	F_3	0.15	0.14	0.21	-0.02	-0.03	-0.04	-0.24		
	F_4	0.06	-0.15	0.36	0.25	0.67**	0.71**	-0.49		
FL (mm)	F_2	0.31**	0.26**	0.11	-0.01	0.19**	0.12*	0.20**	0.05	
	F_3	0.26*	0.25	-0.03	-0.26	0.01	-0.14	0.14	-0.01	
	F_4	-0.08	-0.39	0.94**	0.54*	0.60*	0.88**	0.35	0.31	
UI	F_2	0.17**	0.13*	0.03	0.19**	0.13*	0.23**	0.27**	0.15**	0.05
	F_3	0.27*	0.22	0.23	0.22	-0.04	0.07	0.27*	-0.05	0.45*
	F_4	0.40	0.18	0.91**	0.19	0.45	0.49	-0.02	0.46	0.44

*** and**Significant at 0.05 and 0.01 levels of probability, respectively. LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.**

These results indicate the possibility of genetic improvement for these associated traits by selection for the higher values of boll weight and fiber length except for micronaire reading (the positive correlation with boll weight is an undesirable direction). However, the differences of the genotypic correlation between F_2, F_3 and F_4 generations appeared for fiber

length with lint cotton yield/plant and bolls/plant and pressley index with seed index, lint index and lint percentage. This difference may be due to crossing over across generations and reduced size of F_3 and F_4 generations compared to F_2.

Predicted and realized genetic gains

Predicted and realized gains from the Application 1 (direct selection of lint cotton yield/plant) and Application 2 (direct selection of bolls/plant) are presented in Tables (4 and 5).

Table 4. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 1 (direct selection of lint cotton yield/plant).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	76.19	32.7	90.49	23.51	5.35	38.18	36.13	5.86	23.92	9.50	67.81	11.62	47.39
B/P	65.83	28.24	85.84	22.94	5.39	38.3	33.66	4.06	17.43	8.87	63.00	10.38	44.59
BW (g)	3.16	0.12	4.11	2.98	0.04	1.24	2.92	-0.01	-0.46	0.06	2.05	-0.05	-1.68
SI (g)	10.39	0.21	2.11	10.65	-0.14	-1.25	9.33	-0.12	-1.30	-0.19	-1.75	-0.20	-2.10
L%	36.82	0.42	1.16	34.67	0.61	1.80	37.46	1.27	3.55	0.80	2.36	1.60	4.46
LI (g)	6.06	0.25	4.3	5.67	0.08	1.36	5.59	0.18	3.44	0.10	1.80	0.26	4.88
MR	4.05	0.04	1.12	3.96	0.08	1.96	4.02	0.11	2.73	0.08	2.06	0.11	2.81
PI	10.49	-0.05	-0.46	9.96	-0.10	-0.97	9.98	-0.02	-0.23	-0.11	-1.09	-0.03	-0.30
FL (mm)	35.14	0.08	0.23	32.93	0.27	0.83	32.49	0.51	1.59	0.29	0.89	0.55	1.72
UI	87.23	-0.05	-0.05	84.95	0.45	0.54	83.58	0.38	0.45	0.49	0.58	0.42	0.51
Total		61.96	188.85		12.03	81.99		12.22	51.12	19.89	137.70	24.67	102.27

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

The highest predicted and realized gains from all generations were obtained with direct selection for lint cotton yield/plant and direct selection for bolls/plant in both applications which ranged from 17.43 % with bolls/plant in F_4 to 90.49% with lint cotton yield/plant in F_2 to application 1 and 2. These results can be attributed to the high genotypic correlation coefficients between lint cotton yield/plant and bolls/plant this indicates that bolls/plant was the most effective yield contributing characters and was positively associated with lint yield. The realized gains for lint cotton yield/plant and bolls/plant were higher than predicted gains in F_3 and F_4

generations. These results indicate the predominance of non-additive genetic effects in the inheritance of these traits. Lint percentage and lint index had the same trend with lower gains. Fiber traits did not exhibit neither predicted nor realized gains with the direct selection for lint cotton yield/plant. These results indicated that, applications 1 and 2 could increase lint cotton yield/plant and bolls/plant by 47.39% and 44.59, respectively.

Table 5. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 2 (direct selection of bolls/plant).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	73.43	30.45	84.25	23	5.06	36.1	36.13	5.86	23.92	8.99	64.17	11.62	47.39
B/P	67.05	29.29	89.04	24.06	6.07	43.14	33.66	4.06	17.43	9.99	70.95	10.38	44.59
BW (g)	2.98	-0.03	-1.14	2.86	-0.04	-1.36	2.92	-0.01	-0.46	-0.06	-2.05	-0.05	-1.68
SI (g)	10.21	0.09	0.87	10.59	-0.18	-1.66	9.33	-0.12	-1.3	-0.26	-2.40	-0.20	-2.10
L%	36.73	0.35	0.97	33.45	-0.32	-0.94	37.46	1.27	3.55	-0.42	-1.24	1.60	4.46
LI (g)	5.93	0.15	2.57	5.33	-0.18	-3.22	5.59	0.18	3.44	-0.24	-4.31	0.26	4.88
MR	3.98	0.00	0.00	3.85	-0.03	-0.69	4.02	0.11	2.73	-0.03	-0.77	0.11	2.81
PI	10.45	-0.07	-0.69	10.11	0.03	0.33	9.98	-0.02	-0.23	0.04	0.40	-0.03	-0.30
FL (mm)	34.98	-0.05	-0.13	32.87	0.22	0.68	32.49	0.51	1.59	0.24	0.74	0.55	1.72
UI	87.04	-0.15	-0.18	84.65	0.18	0.21	83.58	0.38	0.45	0.19	0.22	0.42	0.51
Total		60.03	175.56		10.81	72.59		12.22	51.12	18.44	125.70	24.67	102.27

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

Predicted (PG) and realized (RG) gains from the Application 3 (direct selection of boll weight) are presented in Table (6). Direct selection for boll weight revealed the highest predicted gains in F_2 and F_3 for boll weight. However in F_4 generation was for seed index, lint index, micronaire reading and fiber length. Realized gain in F_3 showed the highest value for boll weight however in F_4 generation maintained the same trend in F_3 generation in addition to boll weight. These results indicate that direct selection for boll weight could increase itself and seed index, lint index, micronaire reading and fiber length. This increasement for micronaire reading by direct selection for boll weight is not desirable because this mean less fineness and more roughness.

Table 6. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the application 3 (direct selection of boll weight).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	37.18	0.85	2.35	14.57	0.32	2.26	24.12	-0.20	-0.82	0.56	4.00	-0.4	-1.63
B/P	27.89	-4.29	-13.04	12.93	-0.70	-4.97	20.73	-1.00	-4.28	-1.15	-8.17	-2.55	-10.95
BW (g)	3.65	0.56	18.61	3.31	0.25	8.60	3.22	0.07	2.23	0.39	13.36	0.25	8.42
SI (g)	10.11	0.02	0.22	11.12	0.2	1.81	10.27	0.47	4.91	0.28	2.58	0.74	7.76
L%	36.4	0.10	0.26	33.87	0.00	0.00	35.92	0.04	0.11	0.01	0.03	0.05	0.14
LI (g)	5.77	0.02	0.43	5.73	0.12	2.08	5.77	0.31	5.84	0.16	2.87	0.43	8.07
MR	4.09	0.08	1.91	3.82	-0.05	-1.35	4.18	0.26	6.62	-0.06	-1.55	0.27	6.91
PI	10.53	-0.02	-0.23	10.18	0.09	0.92	10.11	0.10	1.01	0.11	1.09	0.11	1.10
FL (mm)	35.2	0.13	0.36	32.2	-0.40	-1.21	32.83	0.82	2.57	-0.43	-1.32	0.9	2.82
UI	87.57	0.15	0.17	84.4	-0.05	-0.06	83.37	0.19	0.23	-0.05	-0.06	0.21	0.25
Total		-2.40	11.04		-0.22	8.08		1.06	18.42	-0.18	12.84	0.01	22.88

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

These improvements can be attributed to the height genetic correlation between boll weight and seed index, lint index, micronaire reading and fiber length in F_4 generation. The close agreement between predicted and realized gains to selection for boll weight was exhibited. This suggests that dominance effects were lacking or of relatively minor importance. Additive genetic effects would appear to predominate in selected families by Application 3. Similar conclusion was obtained by Miller and Rawlings (1967). Regarding to lint cotton yield/plant and bolls/plant as the main yield traits, direct selection for boll weight did not exhibit any improvement however bolls/plant showed decreasing in predicted and realized gains specially in F_4 by 10.95%. This may be attributed to negative genotypic correlation coefficient for boll weight with both lint cotton yield/plant and bolls/plant.

Regarding to Application (4) (SUB- lint cotton yield/plant, bolls/plant and boll weight) and Application 5 (SH- lint cotton yield/plant, bolls/plant and boll weight) are presented in Tables (7 and 8). These selection procedures involved the most important lint yield traits.

Table 7. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 4 (SUB- lint cotton yield/plant, bolls/plant and boll weight).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	76.01	32.56	90.10	23.49	5.34	38.09	36.13	5.86	23.92	9.48	67.67	11.62	47.39
B/P	65.63	28.07	85.34	23.70	5.85	41.57	33.66	4.06	17.43	9.63	68.39	10.38	44.59
BW (g)	3.19	0.15	5.05	2.93	0.00	0.09	2.92	-0.01	-0.46	0.00	0.00	-0.05	-1.68
SI (g)	10.53	0.31	3.07	10.58	-0.19	-1.72	9.33	-0.12	-1.30	-0.26	-2.40	-0.20	-2.10
L%	36.50	0.17	0.48	33.91	0.03	0.10	37.46	1.27	3.55	0.04	0.12	1.60	4.46
LI (g)	6.06	0.24	4.26	5.43	-0.10	-1.81	5.59	0.18	3.44	-0.14	-2.51	0.26	4.88
MR	4.09	0.07	1.80	3.99	0.10	2.69	4.02	0.11	2.73	0.11	2.84	0.11	2.81
PI	10.47	-0.06	-0.57	10.02	-0.04	-0.39	9.98	-0.02	-0.23	-0.05	-0.50	-0.03	-0.30
FL (mm)	35.09	0.04	0.11	33.06	0.39	1.20	32.49	0.51	1.59	0.43	1.32	0.55	1.72
UI	87.33	0.01	0.02	84.96	0.46	0.55	83.58	0.38	0.45	0.50	0.59	0.42	0.51
Total		61.56	189.66		11.84	80.37		12.22	51.12	19.74	135.52	24.66	102.27

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

Table 8. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 5 (SH- lint cotton yield/plant, bolls/plant and boll weight).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	70.75	28.26	78.19	22.36	4.70	33.54	36.13	5.86	23.92	8.35	59.60	11.62	47.39
B/P	66.59	28.89	87.83	23.88	5.96	42.35	33.66	4.06	17.43	9.81	69.67	10.38	44.59
BW (g)	2.92	-0.09	-2.87	2.86	-0.04	-1.42	2.92	-0.01	-0.46	-0.06	-2.05	-0.05	-1.68
SI (g)	10.19	0.08	0.77	10.61	-0.17	-1.56	9.33	-0.12	-1.30	-0.24	-2.21	-0.20	-2.10
L%	36.27	0.00	0.00	32.92	-0.72	-2.12	37.46	1.27	3.55	-0.94	-2.78	1.60	4.46
LI (g)	5.80	0.05	0.85	5.22	-0.26	-4.72	5.59	0.18	3.44	-0.35	-6.28	0.26	4.88
MR	4.02	0.03	0.66	3.86	-0.02	-0.42	4.02	0.11	2.73	-0.02	-0.52	0.11	2.81
PI	10.41	-0.09	-0.88	10.18	0.10	0.95	9.98	-0.02	-0.23	0.11	1.09	-0.03	-0.30
FL (mm)	35.15	0.09	0.26	32.97	0.31	0.96	32.49	0.51	1.59	0.34	1.04	0.55	1.72
UI	86.94	-0.21	-0.24	84.65	0.18	0.21	83.58	0.38	0.45	0.20	0.24	0.42	0.51
Total		57.01	164.57		10.04	67.77		12.22	51.12	17.20	117.80	24.66	102.27

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

The predicted and realized gains in both selection procedures were positive and relatively high for lint cotton yield/plant and bolls/plant in the three generations; and were positive and slightly high for lint percentage, lint index, micronaire reading and fiber length in F_4 generation. These results indicated that the initial selection for lint cotton yield/plant, bolls/plant and boll weight could improve lint cotton yield/plant and bolls/plant up to more than 40% in the further generations; and could slightly improve lint percentage, lint index and pressley index in the same time. The realized gain for lint cotton yield/plant and bolls/plant were higher than predicted gains in F_3 and F_4 generations. These results confirm the predominance of non-additive genetic effects in the inheritance of these traits. Comparing between the two selection procedures, total predicted gains were higher in F_2 and F_3 for Application 4 than Application 5. However, total realized gains were the same in F_4 generation for both applications because the selected families by each of them involved the same families. The results obtained also confirm the results reported by Salahuddin *et al* (2010).

The Application 6 (SH- lint cotton yield/plant, bolls/plant, boll weight, seed index, lint percentage and lint index) and Application 7 (SH-all studied characters) are presented in Tables (9 and 10). The predicted and realized gains in Application 6 for lint cotton yield/plant and bolls/plant were relatively high in the three generations. This mean selection for all yield traits could improve lint cotton yield/plant and bolls/plant by 32.7% and 24.61% in F_4 generation. Regarding to other yield traits were slightly improved applying this selection procedure. This improvement ranged from 1.05 % for seed index to 8.44% for lint index. Fiber traits they were also slightly improved except micronaire reading and uniformity index. These results indicate that selection for all yield traits at the same time could improve these traits and fiber traits by different ratios. In respect to Application 7, all the studied traits showed improvements. The improvement for lint cotton yield/plant and bolls/plant were not relatively high as the same in the other selection procedures. However boll weight and lint index were relatively high, and the lowest ones were for fiber traits.

Table 9. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 6 (SH- lint cotton yield/plant, bolls/plant, boll weight, seed index, lint percentage and lint index).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	71.59	28.95	80.11	21.58	4.26	30.39	32.53	4.05	16.51	7.56	53.96	8.02	32.71
B/P	66.75	29.03	88.26	22.76	5.28	37.50	29.01	2.24	9.62	8.68	61.65	5.73	24.61
BW (g)	2.93	-0.08	-2.59	2.80	-0.08	-2.78	3.01	0.01	0.41	-0.13	-4.45	0.05	1.68
SI (g)	10.24	0.11	1.10	10.37	-0.34	-3.11	9.63	0.07	0.70	-0.48	-4.43	0.10	1.05
L%	36.46	0.15	0.41	34.20	0.25	0.75	37.55	1.34	3.74	0.33	0.97	1.68	4.68
LI (g)	5.88	0.11	1.95	5.40	-0.13	-2.32	5.79	0.33	6.11	-0.17	-3.05	0.45	8.44
MR	4.05	0.04	1.12	3.92	0.04	0.97	4.08	0.17	4.37	0.04	1.03	0.18	4.60
PI	10.38	-0.11	-1.07	10.18	0.10	0.95	10.28	0.26	2.57	0.11	1.09	0.28	2.80
FL (mm)	35.19	0.12	0.35	32.84	0.19	0.58	32.37	0.39	1.23	0.20	0.61	0.43	1.35
UI	87.07	-0.14	-0.16	84.61	0.14	0.17	82.98	-0.16	-0.19	0.16	0.19	-0.18	-0.22
Total		58.18	169.48		9.71	63.10		8.70	45.07	16.30	107.58	16.74	81.71

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

Table 10. Mean of selected progenies (X_S), predicted gains (PG) and realized gains (RG) in F_2, F_3 and F_4 generations from the Application 7 (SH-all studied characters).

Variable	F_2			F_3			F_4			F_3		F_4	
	X_S	PG	PG%	X_S	PG	PG%	X_S	PG	PG%	RG	RG%	RG	RG%
LCY(g)/P	71.45	28.83	79.78	21.81	4.39	31.33	27.67	1.59	6.49	7.80	55.67	3.15	12.85
B/P	66.24	28.60	86.93	22.96	5.40	38.38	23.64	0.14	0.60	8.89	63.14	0.36	1.55
BW (g)	2.93	-0.08	-2.56	2.83	-0.06	-2.06	3.17	0.05	1.81	-0.09	-3.08	0.20	6.73
SI (g)	10.25	0.12	1.19	10.42	-0.30	-2.73	10.00	0.30	3.14	-0.42	-3.87	0.47	4.93
L%	36.67	0.31	0.85	33.94	0.06	0.17	36.62	0.60	1.67	0.07	0.21	0.75	2.09
LI (g)	5.94	0.16	2.75	5.36	-0.15	-2.75	5.78	0.32	6.09	-0.21	-3.77	0.45	8.44
MR	3.96	-0.01	-0.36	3.93	0.05	1.30	4.14	0.23	5.80	0.05	1.29	0.24	6.14
PI	10.53	-0.02	-0.19	10.07	0.00	0.00	10.18	0.16	1.63	0.00	0.00	0.18	1.80
FL (mm)	35.09	0.04	0.12	33.08	0.42	1.28	32.29	0.32	1.01	0.45	1.38	0.35	1.10
UI	87.45	0.08	0.10	84.87	0.38	0.45	83.30	0.13	0.16	0.41	0.49	0.15	0.18
Total		58.03	168.61		10.19	65.37		3.84	28.40	16.95	111.45	6.30	45.81

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

Comparison among selection procedures

Selection for lint cotton yield/plant and/or for bolls/plant showed the highest predicted and realized gains (Tables 4, 5, 7 and 8). The Applications (1,2, 4 and 5) showed the highest total predicted and realized genetic gains in F_2, F_3 and F_4 and the most of this gains were due to lint cotton yield/plant and bolls/plant. This means maximum gains for lint cotton yield/plant were changed from generation to generation when applying of selection applications. However, selection based on lint cotton yield/plant and/or bolls/plant, would appear to be most effective for the improvement of lint cotton yield/plant and some economic traits. Regarding to the lint percentage and lint index they maintained the same improvement trend in all these selection procedures. In respect to boll weight and seed index the selection applications 3 and 7 showed the highest predicted and realized gains for these two traits. This mean that direct selection for boll weight and selection for all yield traits could improve boll weight and seed index traits.

Some of the fiber traits showed slight improvement across all selection applications specially for pressley index and fiber length traits. However the incorporation of these traits in the selection procedure could improve all fiber traits like Application 7, except for micronaire reading which maintained higher values across all selection applications which consider undesirable values due increasing the fiber roughness.

There was a close agreement between the predicted and realized responses for most of the studied traits, also most of the realized gains were higher than the predicted gains in F_4 generation which indicate the predominance of non-additive genetic variance in the inheritance of these traits.

Selected families scored by using seven different selection procedures for studied characters in F_4 generation

Application of different selection procedures at the early segregating generations of the cross Giza 87 x 10229, could improve lint yield with desirable fiber quality traits to satisfy the requirements of local and foreign spinners. However, if the purpose of breeding program is to improve lint yield selection for lint cotton yield/plant and bolls/plant could produce the highest lint yield with acceptable fiber properties. On the other hand, if the breeding program aimed to improve lint productivity with acceptable fiber

properties, using of Application 6 could produce higher lint yield with desirable fiber length and pressley index. The superior four families released from these seven selection applications in F_4 generation (Table 11) combined lint yield and most of favorable fiber traits and exceeded the F_4 generation mean. These families could be continued to further generations as breeding genotypes for developing higher yield and fiber. Similar findings were reported by El-Lawendey *et al* (2011), El-Lawendey and El-Dahan (2012), El-Dahan *et al* (2017) and AL Hibbiny *et al* (2019).

Table 11. Means of the superior four families scored by using seven different selection procedures for studied characters in F_4 generation.

Trait / Family No.	LCY(g)/ P	B/P	BW (g)	SI (g)	L%	LI (g)	MR	PI	FL (mm)	UR
2/ 2017	31.40	26.15	3.23	10.30	37.23	6.11	4.17	10.55	32.50	83.05
12/2017	23.93	21.13	3.11	9.70	36.01	5.46	4.12	9.80	32.08	83.55
13/2017	38.60	35.45	3.03	9.70	37.06	5.71	4.03	9.95	32.75	84.25
14/2017	33.67	31.88	2.80	8.97	37.87	5.46	4.00	10.00	32.23	82.90
Mean of the superior families	31.90	28.65	3.04	9.67	37.04	5.69	4.08	10.08	32.39	83.44
Mean of the F_4	24.52	23.28	2.97	9.53	35.87	5.33	3.91	10.00	31.94	83.15
Difference%	30.10	23.07	2.36	1.47	3.26	6.75	4.35	0.80	1.41	0.35

LCY/P = Lint cotton yield/plant. B/P = Bolls/plant. BW = Boll weight. SI = Seed index. L% = Lint percentage. LI = Lint index. MR = Micronaire reading. PI = Pressley index. FL = Fiber length. UI = Uniformity index.

REFERENCES

Abbas, H. G., A. Mahmood and Q. Ali (2013). Genetic variability, heritability, genetic advance and correlation studies in cotton (*Gossypium hirsutum* L.). Int. Res. J. Microbiol. 4(6): 156-161.

Abo-Sen, Z.F. (2001). The relative contributions of yield components to cotton lint yield. J. Agric. Sci., Mansoura Univ. 26 (2): 681-685.

AL Hibbiny Y.I.M, B.M. Ramadan, Badeaa A. Mahmoud and A.B.A. EL-Fesheikawy (2019). Effectiveness of some selection procedures for improvement of lint yield in cotton (Gossypium barbadense L.). Egypt. J. Plant Breed. 23(8):1631– 1646

Al-Rawi, K.M. and A.A. Ahmed (1984). Evaluation of the relative efficiencies of several selection indices for predicting yield performance in upland cotton (*Gossypium hirsutum* L.). Iraqi J. Agric. Sci. 2(1): 15-27.

Burton, G.W. (1952). Quantitative inheritance in grasses. Proc. 6th Internat. Grassland Congr. 1: 277-283.

Dewey, D.R. and K.H. Lu (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J. 51(9): 515-518.

El-Dahan, M.A. A., E.M.R Saleh., S.E.S. Ali and H.H.E. Hamed (2017). Relative efficacy of some selection procedures in improving some quantitative traits in an Egyptian cotton cross. Egypt. J. Plant Breed.21(4): 811-824.

El-Lawendey, M. M., Y. A. Soliman, A. R. Abd El-Bary and Y. M. El-Mansy (2008). Using fourteen selection procedures to evaluate predicted and realized genetic gain in the cotton cross Giza 86 x Suvin. Egypt. J. Plant Breed. 12(1): 157-175.

El-Lawendey, M. M., Y. M. El-Mansy and M.A.A. El-Dahan (2011). Economic values effects on genetic gains of lint cotton yield and its components using selection indices. Minufiya J. Agric. Res. 36 (6):1649-1668.

El-Lawendey, M.M. (2003). Effect of some selection procedures on lint yield and seed characters improvement in cotton. Ph.D. Thesis, Fac. Agric., Moshtohor, Zagazig University, Egypt.

El-Lawendey, M.M. and M.A.A. El-Dahan (2012). Comparison between direct and indirect selection and two indices in segregating population of cotton (*Gossypium barbadense* L.). J. Agric. Res. Kafer El-Sheikh Univ., 38(1): 37-53.

El-Mansy, Y. M. (2009). Cluster analysis with selection index for improvement some characters in some cotton genotypes. 1st Nile Delta Conference, Fac. of Agric., Minufia Uni. 135-155.

El-Okkia, A.F.H. (1979). Evaluation of selection indices in Egyptian cotton (*G. barbadense* L.). Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta University, Egypt.

Hassaballa, E.A., E.E. Mahdy, M.A. Khalifa and F.G. Younis (1987). Correlation and path-analysis as affected by selection procedures in an inter-specific cotton population. Assiut J. Agric. Sci. 18(3): 85-100.

Hazel, L.N. (1943). The genetic basis for constructing selection indices. Genetics 28: 476-490.

Huang, Z., D. Ji and J. Pan (2003). Genetics and Breeding of Cotton in China. (ed.: Cotton Research Institute, Chinese Academy of Agricultural Sciences). pp.165, Shandong Science and Technology Press, Jinan, China.

Iqbal, M., K. Hayat, R. S. A. Khan, A. Sadiq and Noor-ul-Islam (2006). Correlation and path coefficient analysis for earliness and yield traits in cotton (*G. hirsutum* L.). Asian J. Plant Sci., 5(2):341-344.

Kamalanathan, S. (1967). A selection index for lint yield in cotton (*Gossypium hirsutum* L.). Madras Agric. J. 54: 612-618.

Kassem, M., G.A. Sary, A.F. El-Okkia and M.M. El-Lawendey (2008). Comparison of the efficiencies of the different selection procedures in three populations of Egyptian cottons (*Gossypium barbadense* L.). Egypt. J. Agric. Res. 86(2):623-629.

Khan, N.U. (2003). Genetic analysis, combining ability and heterotic studies for yield, its components, fibre and oil quality traits in upland cotton (*G. hirsutum*). Ph.D. Dissertation, Sindh Agric. Univ. Tandojam, Pakistan.

Larik, A.S., S.R. Ansari and M.B. Kumbhar (1997). Heritability analysis of yield and quality components in *Gossypium hirsutum* L. Pakistan J. Bot. 29(1): 97-101.

Li, W., T. Zhang, M. Dieters and G. Ye (2009). The effects of component trait selection on genetic gain of lint yield in upland cotton breeding program investigated using simulation. SABRAO J. of Breeding and Genetics. 41(2): 83-100.

Mahdy, E.E. (1983). Selection index in cotton (*G. barbadense* L.). Assiut J. Agric. Sci. 14: 267-282.

Mahdy, E.E., E.A. Hassaballa, M.A. Khalifa and F.G. Younis (1987). Relative efficiency of three selection procedures in improving yield and its components in Egyptian cotton. Assiut J. Agric. Sci. 18(3): 159-175.

McCarty, J.C., J. Wu and J.N. Jenkins (2008). Genetic association of cotton yield with its component traits in derived primitive accessions crossed by elite upland cultivars using the conditional ADAA genetic model. Euphytica. 161: 337-352.

Meena, R.A., M.N. Mishra and R.G. Dani (2001). Genetic variability and correlation for seed-quality parameters in upland cotton (*Gossypium hirsutum* L.). Indian J. Agric. Sci. 71(6): 417-420.

Miller, P.A. and J.O. Rawlings (1967). Selection for increased lint yield and correlated responses in upland cotton, *Gossypium hirsutum* L. Crop Sci. 7: 637-640.

Miller, P.A., J.C. Williams, H.F. Robinson and R.E. Comstock (1958). Estimates of genotypic and environmental variances and covariances in upland cotton and their implications in selection. Agron. J. 50:126-131.

Salahuddin, S.,S. Abro, M.M. Kandhro, L. Salahuddin and S. Laghari (2010). Correlation and path coefficient analysis of yield components of upland cotton (*Gossypium hirsutum* L.) Sympodial. World Appl. Sci. J., 8 (Special Issue of Biotech. & Genet. Engineer.): 71-75.

Smith, H.F. (1936). A discriminant function for plant selection. Ann. Eugenics 7: 240-250.

Soliman, A. M.(2018). Efficiecy of selection index in improvement yield and yield components in segregating population of Eegyptian cotton.Archives of Agric. Sci. J. 1(1): 129-141.

Soliman, Y.A. and M.M. El-Lawendey (2008). Relative efficacy of selection indices for improving lint yield in two intraspecific cotton crosses. Egypt. J. Agric. Res., 86(1):207-222 .

Subandi, W., A. Compton and L.T. Empig (1973). Comparison of efficiencies of selection indices for three traits in two variety crosses of corn. Crop Sci. 13: 184-186.

Walker, J.T. (1960). The use of a selection index technique in the analysis of progeny row data. Emp. Cott. Gr. Rev. 37: 81-107.

Younis, F.G. (1999). Predicted and realized responses to selection procedures for improving yield and its components in Egyptian cotton (*G. barbadense* L.). Al-Azhar J. Agric. Res. 30: 17-23.

الانتحاب لتحسين بعض الصفات المحصولية في القطن

يسرى ابراهيم محمد الحبينى

معهد بحوث القطن – مركز البحوث الزراعية – الجيزة – مصر

أجريت هذه الدراسة في محطة البحوث الزراعية بسخا – معهد بحوث القطن – مركز البحوث الزراعية – مصر خلال مواسم الزراعة من ٢٠١٧ و ٢٠١٩ ويهدف هذا البحث الى تقدير ومقارنة التحسين الوراثي المتوقع والفعلي بتطبيق بعض طرق الانتخاب المختلفة مثل الانتخاب المباشر وادلة الانتخاب والادلة المتعددة للحصول على عائلات متميزة في صفات المحصول وصفات التيلة. لإجراء هذه الدراسة تم استخدام الجيل الثاني والثالث والرابع للهجين (جيزة ٨٧ x ١٠٢٢٩) وتم استخدام سبعة طرق انتخاب حيث تم استخدام طريقة أدلة الانتخاب (ثلاثة أدله) وطريقة الادلة المتعددة لصفات محصول الشعر/نبات، عدد اللوز/نبات ووزن اللوزة وطريقة الانتخاب المباشر للثلاثة صفات محصوليه هي محصول الشعر/نبات، عدد اللوز/نبات ووزن اللوزة. وتلخصت النتائج المتحصل عليها على ما يلي: معظم متوسطات صفات المحصول في الجيل الرابع كانت اعلى من الجيل الثالث مما يوضح التحسين الوراثي الحادث نتيجة استخدام طرق الانتخاب المختلفة. متوسطات صفات التيلة في الجيل الثالث والرابع كانت متقاربه في القيمة مما يعكس الثبات المبكر لمعظم المكونات الوراثية لهذه الصفات. أظهرت طريقة الانتخاب المباشر لمحصول القطن الشعر/نبات (Application 1) ولعدد اللوز على النبات (Application 2) ودليل الانتخاب المتضمن محصول الشعر/نبات وعدد اللوز/نبات ووزن اللوزة (Application 4 and 5) اعلي تحسين وراثي متوقع من الجيل الثالث ويزيد عن ٨٠% من متوسط الجيل الثالث لصفة محصول القطن الشعر/نبات وعدد اللوز على النبات. أظهرت طرق الانتخاب والأدلة المتفوقة في الجيل الثالث نفس التفوق وأعطت اعلي تحسين وراثي متوقع وفعلي في الجيل الرابع لصفة محصول القطن الشعر/النبات. التحسين الفعلي في الجيل الرابع كان أعلي من التحسين المتوقع

في الجيل الثالث ودلت هذه النتائج على ان التباين الوراثي لصفة محصول الشعر/نبات في الاجيال المبكرة لم يستنفذ وان التحسين الوراثي لهذه الصفة يمكن ان يستمر لأجيال اخرى عن طريق الانتخاب المباشر المنسب لصفة محصول الشعر/نبات ولصفة عدد اللوز/نبات وباستخدام طرق الانتخاب (Application 4 and 5). اوضحت النتائج ان طريقة الانتخاب المباشر قد أعطت تحسينا للصفة المتضمنة لها لكل الصفات المنتخبة وبعض الصفات غير المنتخبة حيث بينت النتائج ان صفة وزن اللوزة حسنت نفسها وتلازم هذا التحسين أيضا لصفتي معامل البذرة ومعامل الشعر وطول التيلة. بالرغم من ان التحسين الفعلي لمعظم صفات جودة التيلة لم يتفوق كثيرا عن متوسط الجيل الرابع الا ان استخدام طرق الانتخاب المختلفة في هذه الدراسة نجحت في انتخاب أربع عائلات تجمع بين محصول القطن الشعر/نبات المرتفع (حوالي ٣٠% زيادة عن متوسط الجيل الرابع) مع خصائص جودة تيلة مقبولة وهذا يعد تحسين مقبول جدا من وجهة نظر مربي القطن.