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GENETIC GAIN AND SELECTION CRITERIA EFFECTS ON LINT YIELD AND YIELD COMPONENTS IN SEGREGATING POPULATION (GIZA 88 X A 13)

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ABSTRACT: Gains from application Index selection are very important in cotton breeding program, thus the main objective of this study was to estimate the genetic advance obtained by application of fifteen selection procedures, 11 indices and 4 pedigree line selection after two cycles to improve lint yield and other components with acceptable fiber quality in early segregating population of cross (G.88 * A 13) . The data showed increased in mean performances for all characters with advanced generations from F_2 to F_4 indicating an accumulation of favorable alleles. The advanced generations F_3 and F_4 showed reduction in PCV and GCV as compared with F_2 generation. Most characters showed high heritability values in broad sense over 60 %. Genotypic correlations in most cases were higher than phenotypic ones in both F_2 and F_3 generations. Lint yield / plant, seed cotton yield / plant, bolls / plant showed highly significant positive desirable phenotypic and genotypic correlation with other yield contributed characters in both F_2 and F_3 generations. Boll weight showed desirable significant correlations with other yield characters in both F_2 and F_3 generations. The genetic correlation between fiber length and fiber strength was highly significant positive. The undesirable negative correlation which existed between fiber length with other yield characters in F_2 and F_3 generations were broken and converted to desirable values. The highest predicted genetic advance from F_2 and F_3 generations were obtained with the index $I._{W12}$ followed by $I._{W2}$ and $I._{W23}$ This was true since lint yield /plant showed significant positive correlation with the other yield contributed characters. The highest actual genetic gains from F_3 generation for lint yield /plant occurred by I_{W123}, I_{W12} and most selection indices. Maximum predicted genetic advance for lint yield / plant from F_3 and F_4 generations were achieved when selecting for three components lint yield/plant, bolls/plant and seeds/ boll as well as for lint yield /plant alone. Selection for lint yield /plant alone gave moderate predicted and actual value in three generations followed by index involved lint yield /plant with bolls/plant. The direct selection for seeds/ boll and selection for lint /seed gave low predicted advance in lint yield. Deviation of the actual advance from the predicted ones were positive and low for most indices, which due to the minor relatively role of non –additive effects and the additive genetic effective would appear to be predominant. On the other side high discrepancy was observed between predicted and actual gains from selection when applied selection for seeds/boll, lint /seed and selection index for seeds/boll with lint/seed this was due to non-additive gene effect and large affected by environmental factors High discrepancy was observed between predicted and actual gains from selection for most procedures and advance would decrease in F_4 generation as compared with F_3 for all characters. The role of selection in improvement is that acts on the genetic variances within a population, isolates and increases the desired genetic frequency within the population, and thus, the population means changes towards to a desired value. Thus breeder could selected some families which characterized by high yielding capacity with acceptable fiber

properties and utilize such selected families in breeding program aiming to improvement yield and quality in cotton.

Key words: **Predicted gain, Realized gain, Selection procedures, cotton, improvement, selection index.**

INTRODUCTION

Cotton breeders relay to increase the frequency of combinations which possessed the desirable characters to evolve high yielding varieties with acceptable fiber quality. Improving lint yield, yield components and fiber quality are important objectives in breeding cotton. Gain from selection in a breeding program depend on genetic variation within a population for a given trait, heritability of that trait, and selection intensity (Falconer 1981) .

Since yield is known to be a complex trait and highly affected by environmental conditions, thus, direct selection for yield is not expected to be effective. Therefore, breeder avoids selection for yield and prefers to select for its components individually. The choice of selection and breeding procedures for genetic improvement of cotton is largely conditioned by the type and relative amount of genetic variances component in the population while, the gain from selection in a population depends on genetic variability, heritability and selection intensity (Falconer, 1989). The exploitation of genetically diverse stock in cross combinations helps to identify promising hybrids and / or develop superior lines.

The cotton breeding includes several agronomic and fiber traits, whose association may interfere in the selection process (Araujo *et al.,* 2012). The knowledge of those correlations allows measuring the magnitude of the relationship between several traits of the plant and determines the traits on which the selection can be based , to improve yield and the other fiber quality (Iqbal *et al.,* 2006 and Desalegn *et al.,* 2009).

Selection of superior progenies is a procedure intensive process, once the traits of importance are strongly influenced by the environment and often correlated, so that a selection in one provokes in the others. Therefore, selection to develop superior genotypes based on one or a few traits might be little effective, since a genotype may be obtained that performance superior in relation to the selected trait only (Ramadan et al. (2014) and El -Mansy 2015).

Using of selection index , which is multiple regression of genotypic values on phenotypic values of several traits , and are generally used to discriminate among selection units by taking into account both of the genetic and statistical structure of the population from which the genotypic originated , as well as the economic importance of the traits. (Jesus *et al.*, 2006). The use of selection index is superior in improving complex traits. Furthermore selection index aimed at determining the most valuable genotypes as well as the most suitable combinations of traits with the extension of indirectly the yield in different plants. (El-Lawendey *et al.*, 2011, El-lawendey and El-Dahan, 2012 and El Mansy, 2015).

Thus, the goal of the present study was to estimate and evaluate the efficiency of selection indices and compare it with direct and indirect selection for some economic characters.

MATERIALS AND METHODS

Genetic materials and selection procedures:

The present study was carried out at Sakha Agricultural Research Station, during 2017, 2018 and 2019 growing seasons. The materials used were the F_2, F_3 and F_4 generations of an intra specific cotton (*Gossypium barbadense* L.) cross (G.88 x A 13). Self pollination was practiced for all F_2 plants. Selfed as well as open pollinated bolls/plant of 200 guarded plants and picked up separately and the total seed cotton yield/plant was ginned and lint yield /plant, bolls/plant, seeds/boll, lint/seed, boll weight, seed index and lint percentage were determined.

Using 5 % selection intensity the plants having the highest performance in each selection procedures were saved. These gave a total of 32 F_3 selected progenies. Ten superior progenies from each selection procedure).In 2018 season, part of selfed seeds of 32 selected progenies were evaluated with a random sample of bulked seed of F_3 generation in a randomized complete blocks design with three replicates. Experimental plot was of single row as carried in 2018.The 32 progenies were ranked using fifteen selection procedures. The two superior progenies of each selection procedures were selected using 5 % selection intensity. In 2019 season, selfed seeds of selected progenies (18 progenies) were evaluated with a random sample of bulked seed of F_4 generation and two original parents in a randomized complete blocks design with three replicates. Experimental plot was lay out as same as carried out in 2015.The planting dates were last April 2017, 2018 and 2019seasons. All recommended agronomic practice was applied during the growing season.

Selection procedures were as follows:

Selection indices :

$I._{W123}$	$I._{W12}$	$I._{W13}$	$I._{W23}$	$I._{123}$	$I._{W1}$	$I._{W2}$	$I._{W3}$	$I._{12}$	$I._{13}$	$I._{23}$

Direct selection :

$I._{XW}$ $I._{X1}$ $I._{X2}$ $I._{X3}$

I. refer to index, W refer to lint yield / plant, X1 refer to bolls / plant, X2 refer to seeds/ boll and X3 refer to lint / seed trait.

For example; $I._{W123}$ indicates Selection index involving lint yield/plant, bolls/plant, seeds/boll and lint/seed.

The studied characters were;-

1- Boll weight g (B.W.)
2- Seed cotton yield / plant g (SCY)
3- Lint cotton yield / plant g (Xw) (LCY)
4- Lint percentage (L.P.%)
5- Seed index g (S.I.) g
6- Lint / seed g (X3) (L./S.)
7- Seeds/boll (X2) (S /B.)
8- Bolls/plant (X1) (B./P.)
9- Micronaire reading (MIC.)
10- Fiber strength Presly index (F.S.)
11- Fiber length at 2.5% span length mm (F.L.)
12- Uniformity ratio (UR %)

Statistical and genetic analysis ;

Heritability in broad sense was calculated according to the following expressions.

$$h_b^2 \text{ (in } F_2 \text{ generation)} = \frac{VF_2 - (VP1 + VP_2)/2}{VF_2} \times 100$$

$$h_b^2 \text{ (in } F_3 \text{ and } F_4 \text{ generation)} = \frac{\sigma^2 g}{\sigma^2 p} \times 100$$ **(Walker 1960)**

Where:

V_{F2} = The phenotypic variance of the F_2 population.
V_{P1} = The variance of the first parent
V_{P2} = The variance of the second parent.
σ^2_g = The genotypic variance of the F_3 and F_4 generations.
σ^2_p = The phenotypic variance of the F_3 and F_4 generations.

The phenotypic and genotypic coefficients of variation were estimated using the formula developed by Kearsy and Pooni (1996).

Phenotypic and genotypic correlations coefficients between the studied characters in the three generations were also, computed according to Falconor and Mackey (1996).

The relative importance or economic values (a_i) was calculated according to Walker (1960).

a_w (lint yield/plant)=$\bar{X}_1.\bar{X}_2.X_3$

a_1 (bolls/plant)=$X_2.X_3$

a_2 (seeds/boll)=$X_1.X_3$

a_3(lint/seed)=$X_1.X_2$

Where: X's represent the mean values of the studied characters.

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 and

(a) =Vector of relative economic values.

The formula suggested by Smith (1936) and Hazel (1943) was used in calculating various selection indices:

$I=b_1x_1+b_2x_2+\ldots\ldots\ldots\ldots+b_nx_n$

Predicted improvement in lint yield on the basis of an index was estimated according to the following expression:

Selection advance (SA)= $SD(\sum b_i.\sigma g_{iw})^{1/2}$ (Walker 1960)

Where:

SD denotes selection differential in standard units.

b_i denotes index weights for characters considered in an index.

σg_{iw} denotes genotypic covariance's of the characters with yield.

Predicted genetic advance in lint yield based on pedigree selection was estimated from the following expression: (ΔG_w) due to selection for X_i=$K.\sigma g_{wi}/\sigma p_i$ (Miller and Rawlings 1967).

Also, the predicted response in any selected and unselected character was calculated as suggested by Robinson *et al*., (1951) and Walker (1960).

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

RESULTS AND DISCUSSION

The analysis of variance revealed significant differences among the materials for all studied characters in all generations i.e. F_2, F_3 and F_4 generations. Segregating populations with high mean performance are relatively effective in identifying the superior recombinants. A comparison of mean performance of different studied characters among the three generations, F_2, F_3 and F_4 revealed increase in mean performance for all characters with advanced generations from F_2 to F_4, indicating an accumulation of favorable alleles. This shifting in mean values in desirable direction could largely be attributed to the predominant of additive and additive by additive type of gene action, and also be due to the efficiency of selection procedures application in this study, which agreed with El-Lawendey *et al.,* (2008), Ramdan *et al.,* (2014). The range on index of variability was comparatively wider in F_2 generation as compared with the F_4 generation for most studied characters (Table 1) . The lower limits of range were low in basic population (F_2) generation compared with advanced generations F_3 and F_4 for all studied characters leading to wider spectrum of variability .

Table (1): Means, range, phenotypic (PCV) and genotypic (GCV) coefficients of variation, phenotypic (VP) and genotypic (VG) variances and heritability values in broad-sense for all characters in three generations.

Gener.	Char.	MEAN	Range	Sx	VE	VG	VP	H	GCV	PCV
F2	BW	2.7295	2.2 - 3.5	0.017	0.032	0.027	0.059**	46.24	6.07	8.92
F3		3.17	2.6 - 3.8	0.250	0.014	0.036	0.050**	71.27	5.96	7.07
F4		3.192	3.0 - 3.5	0.121	0.003	0.012	0.015**	81.12	3.41	3.78
F2	SCY/P	59.84	15.9 - 155.2	1.613	70.945	449.118	520.063**	86.36	35.42	38.11
F3		89.81	45.5- 138.3	20.420	23.300	384.450	407.750**	94.29	21.83	22.48
F4		102.553	75.3 - 131.5	14.096	2.018	196.668	198.686**	98.98	13.67	13.74
F2	LCY/P	22.249	6.5 - 59.9	0.609	9.952	64.224	74.176**	86.58	36.02	38.71
F3		34.52	18.1- 53.1	7.700	4.290	52.843	57.133**	92.49	21.06	21.90
F4		39.283	29.4 - 52.5	5.636	0.410	31.353	31.763**	98.71	14.25	14.35
F2	L.P.%	37.128	31.7 - 41.2	0.128	1.568	1.699	3.266**	52.00	3.51	4.87
F3		38.52	34.9- 41.7	1.780	0.131	2.997	3.128**	95.81	4.49	4.59
F4		38.293	35.4 -40.5	1.404	0.041	1.930	1.972**	97.91	3.63	3.67
F2	B/P	21.985	5.7 - 50.3	0.588	9.937	59.164	69.101**	85.62	34.99	37.81
F3		28.53	16.0 - 45.6	6.930	3.070	43.700	46.770**	93.44	23.17	23.97
F4		32.239	22.1- 42.8	4.911	0.383	23.739	24.122**	98.41	15.11	15.23
F2	SI	9.8825	8.4 - 12.3	0.041	0.113	0.218	0.331**	65.90	4.72	5.82
F3		11.22	9.6 - 12.8	0.650	0.059	0.136	0.195**	69.58	3.28	3.93
F4		11.267	10.4 - 12.4	0.388	0.018	0.133	0.151**	88.32	3.24	3.44
F2	S/B	17.032	13.7- 21.8	0.110	1.353	1.053	2.406**	43.77	6.03	9.11
F3		19.35	14.7- 23.8	2.080	0.666	3.193	3.859**	82.74	9.23	10.15
F4		20.333	18.0 - 22.8	1.437	0.063	2.002	2.065**	96.97	6.96	7.07
F2	L/S	0.05846	0.0417 - 0.0707	0.000400	0.000015	0.000015	0.000030**	50.00	6.63	9.37
F3		0.07000	0.0500 - 0.0800	0.010000	0.000016	0.000015	0.000031**	48.54	5.49	7.88
F4		0.07000	0.0595 - 0.0837	0.005400	0.000001	0.000028	0.000029**	96.00	7.58	7.73
F2	Mic	3.9985	3 - 5	0.023	0.045	0.065	0.110**	59.32	6.37	8.28
F3		4.13	2.9 - 5.2	0.410	0.014	0.143	0.157**	91.08	9.16	9.60
F4		4.063	3.2 - 4.7	0.337	0.006	0.107	0.113**	94.67	8.07	8.29
F2	FS	9.5165	8.7 - 10.5	0.030	0.082	0.093	0.175*	52.94	3.20	4.40
F3		10.88	9.4- 12.5	0.610	0.073	0.090	0.162*	55.35	2.76	3.70
F4		11.294	10.2 - 12.2	0.435	0.022	0.167	0.189**	88.20	3.62	3.85
F2	UR %	84.151	81- 86.9	0.090	1.072	0.546	1.617**	33.73	0.88	1.51
F3		85.39	82 - 89.5	1.670	0.194	2.473	2.667**	92.72	1.84	1.91
F4		87.694	85.6 -89.2	0.575	0.203	0.127	0.331	38.54	0.41	0.66
F2	FL mm	32.861	29.2 - 35.8	0.093	0.717	0.993	1.710**	58.08	3.03	3.98
F3		33.5	30.2 - 37.2	1.700	0.141	2.707	2.848**	95.05	4.91	5.04
F4		34.193	31.2 - 37.5	1.825	0.041	3.289	3.330**	98.78	5.30	5.34

*,** indicated significant and high significant at 0.05 and 0.01 probability level

The estimates of genetic variation make the tasked of breeder easy, the PCV and GCV so as to make effective selection. The data in Table 1 revealed that were comparatively high for seed cotton yield / plant, lint cotton yield, bolls/ plant, seeds/boll and boll weight , which indicate the magnitude of genetic variability persisted in these materials was sufficient for providing rather substantial of improvement through application selection of superior progenies . The other characters showed moderate to low values of PCV and GCV such as lint percentage and other fiber characters. It is noteworthy that the advanced generations, F_3 and F_4 showed reduction in PCV and GCV values for all studied characters. This was due to reduction in genetic variability and heterozygote as a result of using different selection procedures which exhausted a major part of variability. Similar results were in agreement with those of El-Mansy (2015).

Heritability in broad sense estimates for all characters under study were improved considerably for most studied characters from F_2 to F_3 and F_4 generations. Most characters showed high heritability values over 60.00 %. These estimates indicate the possibility to success in the selection of the early generations that were evaluated (El-Lawendey and El-Dahan, 2012). Heritability values are useful in predicting the expected progress to be achieved through the process of selection, while genetic coefficient of variation along with heritability estimate provide a reliable estimate of the amount of genetic advance to be expected through phenotypic selection (Eranda *et al.,* 2014).

The cotton breeding includes several agronomic and fiber characters, whose association may interfere in the selection process. Thus the knowledge of this correlation allows measuring the magnitude of the relationship among several characters and determines the character on which the selection can be based, to improve yield and other characters. Results from correlation analysis (Table 2) revealed that the genotypic correlation in most cases were higher than phenotypic correlation in both F_2 and F_3 generations , indicated that the genetic effects were greater than the environmental effects in the expression of these characters . Lint yield / plant, seed cotton yield / plant, bolls / plant showed highly significant positive desirable phenotypic and genotypic correlation with other yield contributed characters in both F_2 and F_3 generations. In the same time boll weight showed desirable significant correlations with other yield characters in both generations. Makhdoom *et al.,* (2010) reported that boll weight is the key independent yield component and play prime role in managing seed cotton yield. Which agreement with Iqbal *et al.,* (2006) and Farooq *et al.,* (2014). The undesirable negative correlation which existed between fiber length with other yield characters in F_2 and F3 generations were broken and converted to desirable values. Fiber length showed significant positive phenotypic and genotypic correlation with fiber strength through both generations.

Similar results were reported by Ramadan *et al.* (2014), El-Mansy (2009) and El-Mansy (2015).

Predicted and actual genetic advance from selection procedures for lint yield /plant alone are presented in Table (3). The highest predicted genetic advance from F_2 and F_3 generations were obtained with the index $I._{W12}$ followed by $I._{W2}$, , $I._{W23}$ and $I._{W3}$, $I._{W123}$ and $I._{W13}$. This was true since lint yield /plant showed significant positive correlation with the other yield contributed characters. The lowest predicted gain for lint yield /plant were observed when selecting for (X_2 , X_3 and I_{23}) lint /seed followed by selection for seeds/boll and selection index involving seeds/boll with lint/seed, such characters showed insignificant correlation with yield .Similar results in agreement with El-Lawendey et al., (2008).

Table (2): The phenotypic and genotypic correlations among studied characters in F_2 (Blow) and F_3 (Above) generations for study population

F2/F3		BW	SCY/P	LCY/P	Lp%	B/P	SI	S/B	L/S	Mic	FS	UR%	fl
BW	r_{ph}		-0.039	-0.069	-0.205	-0.339*	0.179	0.671**	-0.064	0.111	0.034	-0.043	0.171
	r_g		-0.082	-0.122	-0.253	-0.344*	0.108	0.772**	-0.201	0.163	-0.027	-0.083	0.203
SCY/P	r_{ph}	0.136		0.980**	-0.218	0.949**	-0.047	-0.320*	-0.203	0.049	-0.031	-0.023	0.154
	r_g	0.202*		0.980**	-0.254	0.961**	-0.204	-0.402**	-0.345*	0.031	-0.115	-0.053	0.141
LCY/P	r_{ph}	0.134	0.991**		-0.025	0.935**	-0.042	-0.334*	-0.051	0.082	-0.031	-0.076	0.119
	r_g	0.152*	0.993**		-0.061	0.949**	-0.235*	-0.433**	-0.181	0.060	-0.128	-0.116	0.099
Lp%	r_{ph}	0.009	0.072	0.193*		-0.164	0.043	-0.085	0.800**	0.143	-0.010	-0.274*	-0.214
	r_g	-0.463**	0.156*	-0.234*		-0.193	-0.112	-0.157	0.879**	0.123	-0.084	-0.313*	-0.249*
B/P	r_{ph}	-0.087	0.972**	0.963**	0.070		-0.102	-0.490**	-0.190	0.015	-0.038	0.006	0.100
	r_g	0.029	0.982**	0.846**	0.224*		-0.229	-0.578**	-0.295*	-0.013	-0.095	-0.014	0.085
SI	r_{ph}	0.442**	0.029	0.005	-0.147	-0.072		0.394*	0.631**	0.077	-0.065	0.011	0.062
	r_g	0.650**	0.050	-0.018	-0.341**	-0.061		0.278*	0.374*	0.056	-0.313	-0.095	-0.039
S/B	r_{ph}	0.946**	0.130	0.129	0.013	-0.084	0.422**		0.166	0.222	-0.075	0.015	-0.024
	r_g	0.605**	0.097	0.058	-0.121	-0.127	0.558**		-0.018	0.211	-0.136	-0.026	-0.078
L/S	r_{ph}	0.299	0.076	0.165*	0.768**	0.007	0.515**	0.289		0.147	-0.041	-0.202	-0.123
	r_g	0.070	0.169*	-0.220*	0.576**	0.148*	0.398**	0.294		0.132	-0.220	-0.335*	-0.248*
Mic	r_{ph}	0.243**	0.167	0.219*	0.402**	0.119	0.204*	0.223	0.469**		0.119	-0.218	0.097
	r_g	0.307**	0.291**	-0.367**	0.379**	0.242*	0.278**	0.522	0.501**		0.133	-0.259*	0.075
FS	r_{ph}	0.046	0.002	-0.050	-0.396**	-0.015	0.057	0.035	-0.302**	-0.335**		0.103	0.262*
	r_g	0.062	-0.028	0.124	-0.687**	-0.049	0.171*	-0.210	-0.454**	-0.343**		0.104	0.451**
UR%	r_{ph}	0.198	0.210*	0.153	-0.405**	0.172*	0.190*	0.200	-0.233*	-0.079	0.533**		0.160
	r_g	0.507**	0.412**	-0.339**	-0.945**	0.328**	0.486**	0.128	-0.460**	0.191*	0.300**		0.154
FLmm	r_{ph}	0.031	0.052	0.017	-0.292	0.052	0.021	0.024	-0.238*	-0.031	0.476**	0.583**	
	r_g	0.253**	0.012	0.003	-0.004	-0.017	0.042	-0.217	0.045	0.267*	0.472**	0.897**	

*,** indicated significant and high significant at 0.05 and 0.01 probability level

Table (3): Predicted and actual genetic advances of lint yield (X_w) /plant and selection advances (S.A. %) from F_2 , F_3 and F_4 generations for different selection procedures in population (G.88 * Australly 13)

	∆g xw	*F2*		*F3*				*f4*		
NO	*Indices*	*pre.*	*S.A.%*	*Act*	*act. %*	pre.	S.A.%	*Act*	*Pre*	S.A.%
1	*I.W123*	*24.133*	*108.46*	*25.782*	*115.88*	23.40	67.78	13.638	19.68	57.02
2	*I.W12*	*25.349*	*113.93*	*25.026*	*112.48*	23.35	67.63	14.593	19.68	57.02
3	*I.W13*	*22.182*	*99.69*	*24.026*	*107.99*	23.30	67.49	12.755	19.67	56.97
4	*I.W23*	*24.614*	*110.63*	*23.119*	*103.91*	23.03	66.71	12.045	19.66	56.96
5	*I.123*	*15.948*	*71.68*	*20.876*	*93.83*	23.36	67.67	9.655	19.18	55.55
6	*I.W1*	*17.545*	*78.86*	*19.626*	*88.21*	24.47	70.88	13.190	19.74	57.18
7	*I.W2*	*24.822*	*111.56*	*18.724*	*84.15*	23.24	67.32	5.380	19.66	56.95
8	*I.W3*	*24.495*	*110.09*	*22.912*	*102.98*	22.73	65.86	5.638	19.62	56.85
9	*I.12*	*15.791*	*70.97*	*21.679*	*97.44*	23.48	68.02	-2.380	18.96	54.92
10	*I.13*	*15.698*	*70.55*	*20.27*	*91.10*	23.27	67.42	10.347	18.87	54.67
11	*I.23*	*-0.809*	*-3.64*	*19.714*	*88.61*	10.62	30.76	6.220	11.40	33.03
12	*xw*	*15.361*	*69.04*	*11.3*	*50.79*	14.40	41.72	5.280	11.46	33.20
13	*x1*	*6.462*	*29.04*	*8.351*	*37.53*	14.77	42.8	5.400	11.02	31.93
14	*x2*	*-0.318*	*-1.43*	*7.916*	*35.58*	-6.75	-19.55	3.120	-6.68	-19.36
15	*x3*	*1.283*	*5.76*	*6.4218*	*28.86*	-2.82	-8.17	-2.700	2.44	7.06
	m.xw F2	*22.249*						*m.xw* F3	*34.52*	

The highest actual genetic gains from F_3 generation for lint yield /plant occurred by I_{W123}, I_{W12} and most selection indices. The actual gains were approximately with predicted advance from F_2 . While, actual advance from direct selection were smaller as compared with obtained from index selection. Actual genetic advance from F_4 generation were decreased as compared with predicted advance from F_3.

Deviation of the actual advance from the predicted ones (Figures 1 and 2) were positive and low for most indices, which due to the minor relatively role of non – additive effects and the additive genetic effective would appear to be predominant. On the other side high discrepancy was observed between predicted and actual gains from selection when applied selection for seeds/boll, lint /seed and selection index for seeds/boll with lint/seed this was due to non-additive gene effect and large affected by environmental factors. Results are in harmony with those reported by Gooda (2001), El-lawendey *et al.*, (2011) and Ramadan *et al.,* (2014).

Maximum predicted genetic advance for lint yield /plant from F_3 and F_4 generations were achieved when selecting for lint yield/ plant, bolls/plant and seeds/boll followed by selecting for three previous characters as well as for lint yield alone. These main attributes for lint yield. On the other side, selecting for seeds / boll and lint /seed exhibited minimum predicted and actual genetic gains for lint yield /plant followed index involve both characters. The indices I_{W12} and Iw123 recorded maximum actual value in F_4 generation.

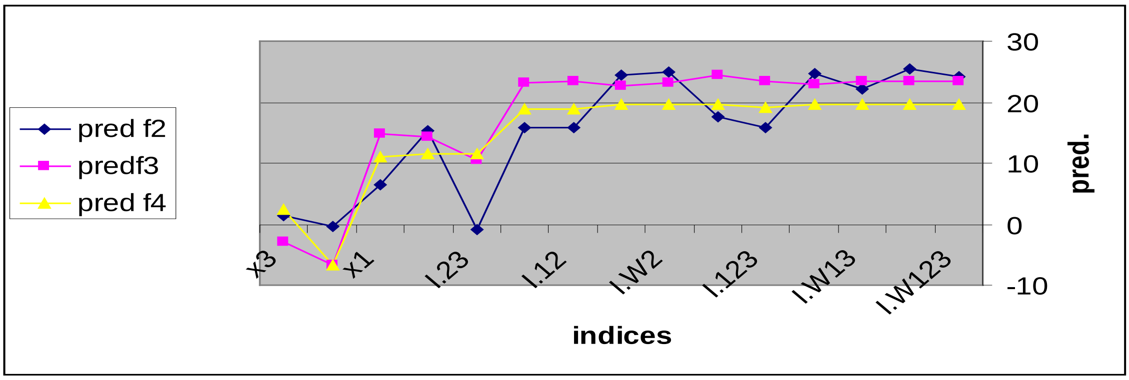


Figure 1. Predicted advance in lint yield/plant improvement curves as a result of using 15 selection indices in F_2 , F_3 and F_4 generations

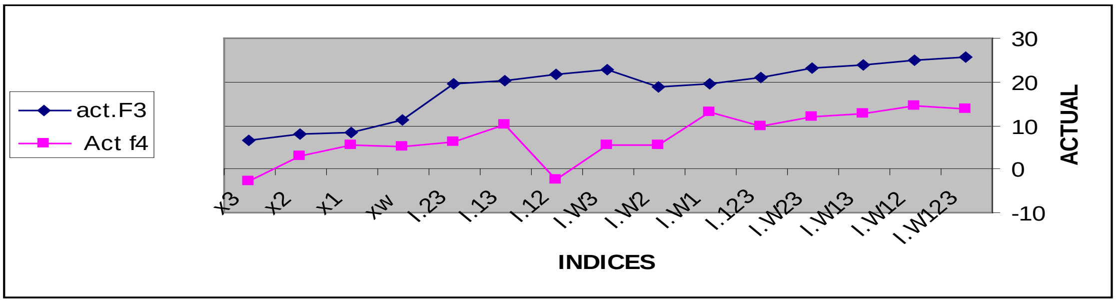
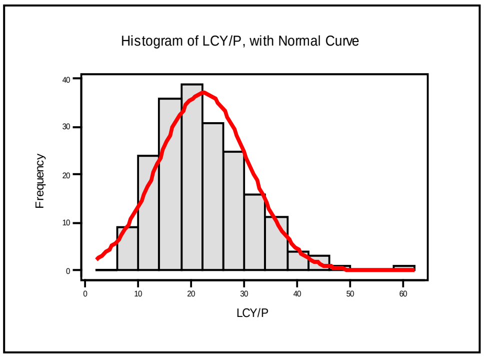


Figure 2. Actual lint yield/plant improvement curve as a result of using 15 selection indices in F_3 and F_4 generations.

High discrepancy was observed between predicted and actual gains from selection for most procedure in F_3 and F_4 generation this due to non-additive gene effect and large affected by environment conditions. Also, predicted and actual genetic gains from F_4 generation were decreased as compared with the previous generations F_2 and F_3. This was due to applied of different selection procedures through two cycles which exhausted of most genetic variability. This results were in a good agreement with Ramadan et al. (2014) and El- Mansy (2015).

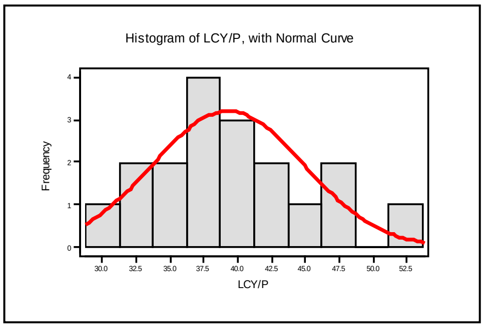
The mean population was change from F_2 generation to F_4 generation by effect selection procedures. The mean F4 was higher than F2 generation in lint yield characters as showed in Figure 3.

Estimation predicted advance for all studies characters from indirect selection were depend on genetic variance, covariance and phenotypic variances in F_2 and F_4 generations are presented in Table 4. The results indicated that predicted genetic advance in F_2 often higher than obtained from F_4 for most characters. These results indicated that high genetic variability in F_2 generation were play role in high improvement than F_4 generation. Similar results with Younis, (1999), Ramdan, et al., (2014) and Abd EL-Aty et al. (2017).



F_2 generation before selection
(Basic population G.88 x Astrualy 13)

→



F_4 generation after selection

Figure 3. The role of selection indices in improvement lint yield trait in F_4 generation (within population).

Table (4): Predicted genetic advances of most studied characters (from F_2 (below) and F_4 (above) generations from indirect selection in population (G.88* Australly 13).

→		Predicted genetic advance in selected and unselected characters were detrmained in F4										
Predicted genetic advance in selected and unselected characters were detrmaine in F2 ↓		BW	SCY/P	Lp	B/P	SI	S/B	L/S	Mic	FS	UR	fl
	BW	0.2134	-0.0888	-0.0583	-0.127	-0.037	0.13	-0.061	0.076	0.125	0.035	-0.0101
	SCY/P	0.030	28.8159	0.2101	28.23	-1.245	-14.16	-0.483	-5.345	-11.52	7.468	3.7845
	Lp	-0.1162	3.2196	2.8472	0.16	0.86	-1.27	2.563	-1.033	-0.533	-0.524	-0.993
	B/P	0.0309	16.8395	0.4269	9.997	-0.176	-5.643	0.312	-2.291	-4.704	1.979	1.2393
	SI	0.0691	1.082	-0.4689	-0.166	0.729	-0.088	0.513	-0.016	0.086	0.012	-0.0509
	S/B	0.0682	-0.2561	-0.2392	-0.611	0.105	2.893	-1.16	1.98	1.523	-0.307	0.0374
	L/S	-0.0545	3.5222	-0.2652	1.604	-0.019	0.002	0.011	-0.003	-9E-04	-0.001	-0.0033
	Mic	0.0197	5.8482	0.0358	1.93	0.085	0.495	6E-04	0.666	0.338	-0.158	-0.0079
	FS	0.0039	-0.9494	-0.6059	-0.436	0.086	-0.378	-0.001	-0.017	0.817	-0.014	-0.3328
	UR	0.0506	5.5305	-0.7213	1.544	0.159	-0.163	-9E-04	0.085	-0.12	0.639	-0.0433
	FL	0.0579	-0.821	0.5358	-0.644	0.018	-0.389	0.002	0.118	0.02	0.276	3.7246

Improvement in unselected characters as a result application 15 selection procedure in F_3 are presented in Table 5. Actual gains in unselected characters were positive value for boll weight, seed cotton yield / plant, lint percentage, seed index, micronaire value and fiber length for 15 selection procedure. The improvement depend on positive genetic association between select and other unselected characters. The index selection were superior in actual advance in most characters as compared with direct selection for lint yield, bolls/plant, seeds/boll and lint/ seed except lint percentage , seed index and fiber strength . The direct selection for seed /boll and lint /seed recorded improvement in lint percentage, seed index and micronair reading (negative value was disable) than other indices.

The actual advance in F_4 generation are presented in Table 6. The indices; Iw123, I.w12, I.W13 , I.w23 , I.W1 and I.13 recorded high actual advance in seed cotton yield / plant . The actual genetic advance improvement in F_4 generation decreased significantly from the F_3 generation. As a result of the depletion of genetic variances, the continuation of improvement, the stopping of the feasibility of selection, and the stability of genotypes within the population. These results coincide with Ramdan et al 2014, El-Mansy, (2015) and Abd El-Aty et al 2017.

The role of selection in improvement is that acts on the genetic variances within a population, isolates and increases the desired genetic frequency within the population, and thus, the population means changes towards to a desired value. Accordingly, the top 12 families with the most characteristics were isolated from F_4 are presented in Table 7.

Table 5. Improvement in unselected characters actual and actual advance as a result application of 15 selection procedures in F_3 generation .

		Actual from F3							Actual %						
	Ind	BW	SCY/P	Lp	SI	Mic	FS	FL	BW	SCY/P	Lp	SI	Mic	FS	FL
1	I.W123	*0.47*	*65.04*	*1.33*	*1.16*	*0.13*	*1.16*	*1.09*	*17.24*	*108.69*	*3.59*	*11.75*	*3.16*	*12.17*	*3.31*
2	I.W12	*0.47*	*62.32*	*1.59*	*1.06*	*0.04*	*1.34*	*1.61*	*17.05*	*104.14*	*4.29*	*10.75*	*1.04*	*14.12*	*4.91*
3	I.W13	*0.43*	*60.56*	*1.3*	*1.10*	*0.09*	*1.33*	*1.71*	*15.86*	*101.21*	*3.49*	*11.10*	*2.33*	*13.97*	*5.20*
4	I.W23	*0.42*	*58.3*	*1.26*	*1.18*	*0.14*	*1.32*	*1.74*	*15.41*	*97.43*	*3.39*	*11.92*	*3.61*	*13.82*	*5.28*
5	I.123	*0.40*	*53.46*	*0.88*	*1.20*	*0.12*	*1.44*	*1.59*	*14.67*	*89.33*	*2.38*	*12.12*	*3.04*	*15.17*	*4.85*
6	I.W1	*0.37*	*48.69*	*1.48*	*1.21*	*0.19*	*1.30*	*0.50*	*13.66*	*81.37*	*3.98*	*12.23*	*4.81*	*13.68*	*1.52*
7	I.W2	*0.38*	*46.55*	*1.42*	*1.22*	*0.22*	*1.37*	*0.63*	*13.85*	*77.79*	*3.83*	*12.32*	*5.41*	*14.35*	*1.92*
8	I.W3	*0.40*	*58.77*	*0.90*	*1.19*	*0.09*	*1.35*	*1.45*	*14.75*	*98.21*	*2.43*	*12.07*	*2.18*	*14.16*	*4.41*
9	I.12	*0.35*	*56.35*	*0.59*	*1.11*	*0.05*	*1.36*	*1.38*	*13.00*	*94.17*	*1.59*	*11.18*	*1.13*	*14.31*	*4.20*
10	I.13	*0.38*	*50.8*	*1.34*	*1.21*	*0.18*	*1.32*	*0.71*	*14.03*	*84.90*	*3.62*	*12.26*	*4.52*	*13.90*	*2.15*
11	I.23	*0.36*	*49.93*	*1.12*	*1.16*	*0.15*	*1.33*	*0.72*	*13.01*	*83.43*	*3.01*	*11.70*	*3.69*	*14.01*	*2.20*
12	xw	*0.78*	*21.63*	*0.82*	*1.33*	*0.33*	*1.25*	*0.75*	*28.59*	*36.15*	*2.21*	*13.43*	*8.29*	*13.12*	*2.28*
13	x1	*0.73*	*20.92*	*0.80*	*1.45*	*0.27*	*1.25*	*0.45*	*26.92*	*34.97*	*2.15*	*14.70*	*6.65*	*13.19*	*1.36*
14	x2	*0.34*	*15.42*	*3.00*	*1.75*	*-0.17*	*1.35*	*0.69*	*12.47*	*25.76*	*8.09*	*17.68*	*-4.21*	*14.17*	*2.10*
15	x3	*0.32*	*11.61*	*3.04*	*1.71*	*-0.10*	*1.30*	*0.66*	*11.89*	*19.41*	*8.18*	*17.29*	*-2.46*	*13.71*	*2.00*
M. F2 Gen.		2.73	59.84	37.13	9.88	4.0	9.52	32.86	2.73	59.84	37.13	9.88	4	9.52	32.86

Table 6. Improvement in unselected characters actual and actual advance as a result application 15 selection procedure in F_4 generation.

No.		Actual from F4							Actual % from F4						
		BW	*SC*	*LP*	*SI*	*MIC*	*FS*	*FL*	*BW*	*SC*	*LP*	*SI*	*MIC*	*FS*	*FL*
1	I.w123	-0.028	33.740	0.438	0.047	-0.055	0.145	0.508	*-0.89*	*37.57*	*1.14*	*0.42*	*-1.33*	*1.33*	*1.52*
2	I.w12	-0.045	36.440	0.355	0.167	-0.130	0.007	1.338	*-1.42*	*40.57*	*0.92*	*1.49*	*-3.15*	*0.07*	*3.99*
3	I.W13	-0.001	32.296	0.174	-0.039	-0.061	0.126	1.106	*-0.04*	*35.96*	*0.45*	*-0.35*	*-1.48*	*1.16*	*3.3*
4	I.w23	0.005	29.680	0.455	0.155	-0.065	0.305	0.880	*0.16*	*33.05*	*1.18*	*1.38*	*-1.57*	*2.8*	*2.63*
5	I.123	0.055	23.590	0.480	0.317	-0.080	0.545	1.438	*1.74*	*26.27*	*1.25*	*2.83*	*-1.94*	*5.01*	*4.29*
6	I.W1	-0.032	29.215	1.555	0.317	-0.130	0.395	-0.138	*-1.03*	*32.53*	*4.04*	*2.83*	*-3.15*	*3.63*	*-0.41*
7	I.W2	0.018	17.359	-1.251	-0.070	-0.186	0.307	0.975	*0.55*	*19.33*	*-3.25*	*-0.62*	*-4.51*	*2.83*	*2.91*
8	I.W3	0.030	17.223	-0.945	-0.178	-0.222	0.353	1.317	*0.95*	*19.18*	*-2.45*	*-1.59*	*-5.37*	*3.25*	*3.93*
9	I.12	0.130	-2.235	-1.833	-0.045	0.145	0.657	2.138	*4.1*	*-2.49*	*-4.76*	*-0.4*	*3.51*	*6.04*	*6.38*
10	I.13	0.038	25.173	0.522	0.147	-0.022	0.503	0.575	*1.21*	*28.03*	*1.35*	*1.31*	*-0.52*	*4.63*	*1.72*
11	I.23	-0.020	12.140	1.418	0.605	-0.380	0.395	0.025	*-0.63*	*13.52*	*3.68*	*5.39*	*-9.2*	*3.63*	*0.07*
12	XW	0.088	14.898	-0.570	-0.137	0.137	0.520	-0.217	*2.79*	*16.59*	*-1.48*	*-1.22*	*3.31*	*4.78*	*-0.65*
13	X1	-0.032	10.665	1.180	0.730	0.170	0.895	-0.938	*-1.03*	*11.88*	*3.06*	*6.51*	*4.12*	*8.23*	*-2.8*
14	X2	0.124	8.715	-0.326	-0.151	0.195	0.657	-0.450	*3.90*	*9.70*	*-0.85*	*-1.35*	*4.72*	*6.04*	*-1.34*
15	X3	0.163	-4.768	-1.087	-0.095	0.220	0.795	1.042	*5.15*	*-5.31*	*-2.82*	*-0.85*	*5.33*	*7.31*	*3.11*
M.F3		*3.17*	*89.81*	*38.52*	*11.22*	*4.10*	*10.88*	*33.50*	*3.17*	*89.81*	*38.52*	*11.22*	*4.10*	*10.88*	*33.50*

Table 7. Rank of the best families selected in the F4 generation on the recipe for lint yield / plant.

Rank	2017	2018	2019	BW	SCY/P	LCY/P	Lp.%	B/P	SI	S/B	L/S	Mic	FS (P.i.)	UR.%	FL mm
LCY/P	F2	F3	F4												
6	6	2	1	*3.10*	*116.00*	*42.40*	*36.50*	*37.48*	*10.63*	*18.80*	*0.0611*	*3.88*	*11.38*	*88.20*	*34.70*
10	46	6	3	*3.10*	*94.90*	*37.80*	*39.80*	*30.58*	*11.50*	*18.80*	*0.0760*	*3.45*	*10.65*	*88.00*	*33.60*
9	106	9	5	*3.30*	*106.20*	*38.90*	*36.60*	*32.18*	*11.15*	*22.00*	*0.0644*	*4.15*	*11.58*	*87.90*	*32.60*
7	119	14	8	*3.20*	*98.90*	*39.20*	*39.60*	*30.95*	*11.35*	*18.50*	*0.0745*	*3.70*	*10.75*	*87.30*	*37.10*
8	121	16	9	*3.20*	*107.60*	*39.10*	*36.40*	*34.28*	*11.48*	*19.00*	*0.0656*	*4.05*	*11.05*	*88.20*	*33.50*
5	131	19	10	*3.20*	*109.00*	*43.70*	*40.10*	*34.08*	*12.15*	*19.30*	*0.0814*	*4.05*	*11.90*	*88.10*	*33.50*
2	139	21	11	*3.20*	*123.50*	*46.50*	*37.70*	*38.88*	*11.85*	*20.40*	*0.0717*	*4.05*	*11.13*	*88.00*	*36.40*
12	142	22	12	*3.10*	*96.30*	*36.90*	*38.30*	*31.35*	*11.33*	*21.00*	*0.0702*	*4.05*	*11.18*	*87.20*	*34.00*
4	165	26	14	*3.30*	*117.80*	*44.60*	*37.90*	*36.30*	*10.93*	*20.50*	*0.0667*	*4.05*	*10.95*	*87.90*	*36.40*
1	167	27	15	*3.10*	*129.00*	*51.70*	*40.10*	*41.85*	*10.93*	*18.10*	*0.0730*	*3.95*	*10.65*	*87.50*	*33.30*
11	183	30	16	*3.10*	*100.50*	*37.60*	*37.40*	*32.73*	*11.10*	*20.40*	*0.0662*	*4.20*	*11.35*	*86.90*	*36.50*
3	194	31	17	*3.20*	*118.20*	*46.30*	*39.10*	*37.28*	*11.03*	*21.00*	*0.0709*	*4.23*	*11.30*	*88.00*	*32.40*
Mean selected familes From F4				*3.20*	*109.80*	*42.10*	*38.30*	*34.80*	*11.30*	*19.80*	*0.0701*	*4.00*	*11.20*	*87.70*	*34.50*
M.F2				*2.73*	*59.84*	*22.25*	*37.13*	*21.99*	*9.88*	*17.03*	*0.0580*	*4.00*	*9.52*	*84.15*	*32.86*
M.F3				*3.17*	*89.81*	*34.52*	*38.52*	*28.53*	*11.22*	*19.35*	*0.0700*	*4.10*	*10.88*	*85.39*	*33.50*
M.F4				*3.19*	*102.55*	*39.28*	*38.29*	*32.24*	*11.27*	*20.33*	*0.0700*	*4.10*	*11.29*	*87.69*	*34.19*
cheek				*3.20*	*68.48*	*24.60*	*36.03*	*21.35*	*11.03*	*19.95*	*0.0620*	*4.00*	*9.38*	*84.85*	*33.43*
M.S.F. L.S.D0.05				*0.15*	*4.02*	*1.81*	*0.57*	*1.75*	*0.38*	*0.71*	*0.0031*	*0.22*	*0.42*	*1.28*	*0.57*
M.S.F. L.S.D0.01				*0.20*	*5.42*	*2.45*	*0.78*	*2.36*	*0.51*	*0.96*	*0.0041*	*0.30*	*0.57*	*1.72*	*0.77*

The selected families were exceeded F_3 families mean for all yield potentials and fiber quality characters. The breeder may use these selected families in breeding programs aimed at improving yield. The selection families were exceeded F_3 families mean for all yield potentials and fiber quality characters. The breeder may use these selected families in breeding programs aimed at improving yield and quality in cotton.

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العائد الوراثى المتحقق بالانتخاب وتاثيره على محصول الشعر ومكونات المحصول فى عشيرة انعزاليه من القطن (Giza 88 x A13)

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الملخص العربي

المكاسب الوراثية من تطبيق دليل الانتخاب Index Selection مهمة جدا في برامج التربية ولذلك كان الهدف من تلك الدراسة هو الحصول علي تحسين في عدد من الصفات عن طريق تقدير التقدم الوراثي بتطبيق ١٥ من اجراءات الانتخاب التي تضم ١١ دليل انتخابي تتبع دليل الانتخاب Index Selection و ٤ ادلة انتخاب مباشر و تقيم التحسين الوراثي لكل دليل بعد دورتين انتخاب داخل عشيرة انعزالية من القطن هي هجين جيزة ٨٨ * استرالي ١٣.

اوضحت النتائج زيادة متوسطات الصفات في الجيل الرابع عن الجيل الثاني و الثالث و ذلك نتيجة تجميع اليلات وراثية مرغوبة كما ان التباين الوراثي قد انخفض في الجيل الرابع عن الجيلين الثاني و الثالث و كذلك معامل الاختلاف المظهري و الوراثي ودرجة التوريث بالمفهوم الواسع كانت عالية لجميع الصفات المدروسة اكبر من ٦٠ %.

اظهرت صفة محصول الشعر للنبات ومحصول القطن الزهر وعدداللوز للنبات ارتباط وراثى ومظهرى مرغوب مع باقى صفات مكونات المحصول لكل من الجيل التانى والثالث كما وجد ارتباط معنوى مرغوب بين صفى وزن اللوزة مع صفات المحصول الاخرى.

اظهرت النتائج ان اعلى تحسين ورای متوقع فى الجيل الثانى عند استخدام دليل الانتخاب (محصول الشعر مع عدد اللوز للنبات مع عدد البذور للوزة) يليه الدليل الانتخابى المتضمن محصول الشعر للنبات مع عدد اللوز للنبات والدليل المتضمن محصول الشعر للنبات مع عدد البذور للوزه وكمية الشعر على البذره.فيما كان اعلى تحسين فعلى فى الجيل الثالث تم الحصول عليه بتطبيق دليل الانتخاب التضمن محصول الشعر للنبات مع عدد اللوز وعدد البذور لكل لوزة وكمية الشعر على البذره .

وجد ان اعلي تحسن وراثي متوقع في صفة محصول القطن الشعر فى الجيل الثالث والرابع تم الحصول عليه من خلال ادلة الانتخاب التي تضم الانتخاب لصفات المحصول الشعر / نبات و عدد اللوز / نبات و عدد البذرة / لوزة و هذه الادلة تتبع دليل الانتخاب لعديد من الصفات و هذه الادلة كانت اعلي في زيادة صفة محصول شعر / نبات عن دليل الانتخاب المباشر لصفة المحصول الشعر الذي اعطي تحسينا اقل . التحسين الوراثي المتوقع لصفة محصول الشعر في جيل ثاني كان مساويا تقريبا للتحسين الفعلي الذي تم حصول عليه في جيل الثالث فى حين ان التحسين الوراثي المتوقع لصفة المحصول الشعر في الجيل الرابع قد انخفض كثيرا عن تحسين متوقع في الجيل الثاني و الثالث .

اظهرت النتائج ان الانحراف بين قيم التحسين الوراثى الفعلى ةالمتوقع ذات قيما صغيرة موجبه لمعظم ادلة الانتخاب مما يدل على اهمية الفعل الجينى المضيف كما اظرت النتائج ايضا عدم توافق قيم كل من التحسين الفعلى ةالمتوقع عند تطبيق الانتخاب المباشر لصفة عدد البذور فى اللوز والانتحاب لصفة كمية الشعر لكل بذرة والدليل الانتخابى المتضمن كلا الصفتين.

يتلخص الدور الذى يلعبه الانتخاب في التحسين حيث يعمل علي الاختلافات الوراثية داخل العشيرة (عزل وزيادة التكرارات الجينية المرغوبة) داخل العشيرة و بناءا عليه يتغير متوسط العشيرة حسب رغبة المربي الى قيما مرغوبة.

وعلى هذا يمكن للمربى انتخاب بعض العائلات التى تتميز بالقدرة الانتاجيه العالية مع صفات الجوده المقبولة والاستفادة منها في برامج التربية واستكمال العمل عليها لانتاج اصناف جديدة .

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